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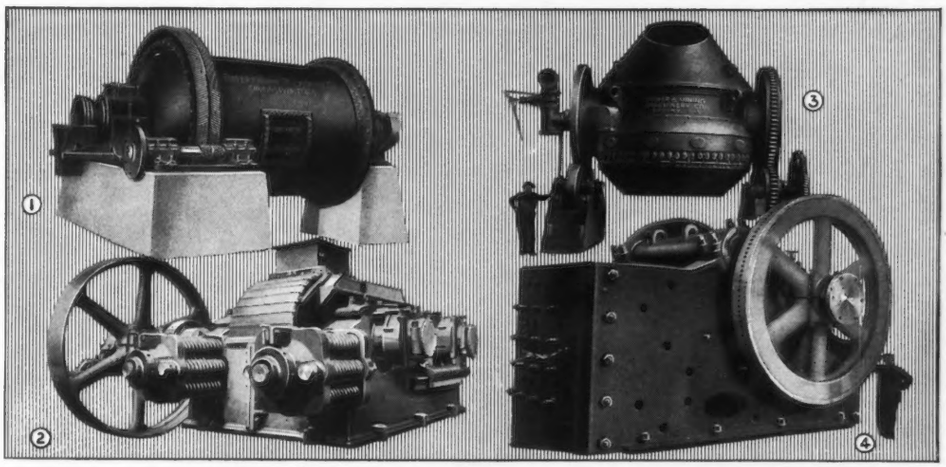

Fig. 1. 10′ diameter Tube Mill Dec. 1912. With the large diameter tube mill a marked increase in efficiency is obtained. Leading plants are discarding the small diameter mill in its favor.

Fig. 2. 72″ diameter Garfield Crushing Roll, May, 1910. Built for Utah Copper Company. Known the world over.

Fig. 3. 12′ Great Falls Type Converter, March, 1912. First built for the market by the Power & Mining Machinery Co., and installed at the Great Falls Plant of the Anaconda Copper Mining Company.

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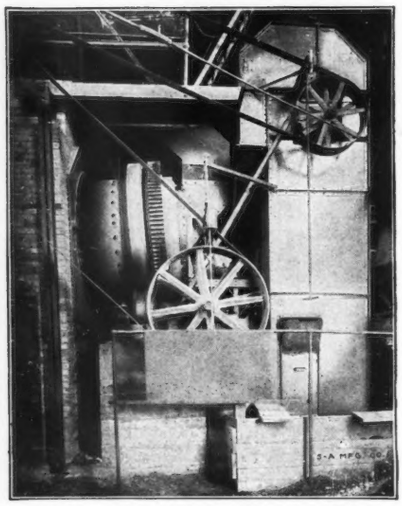

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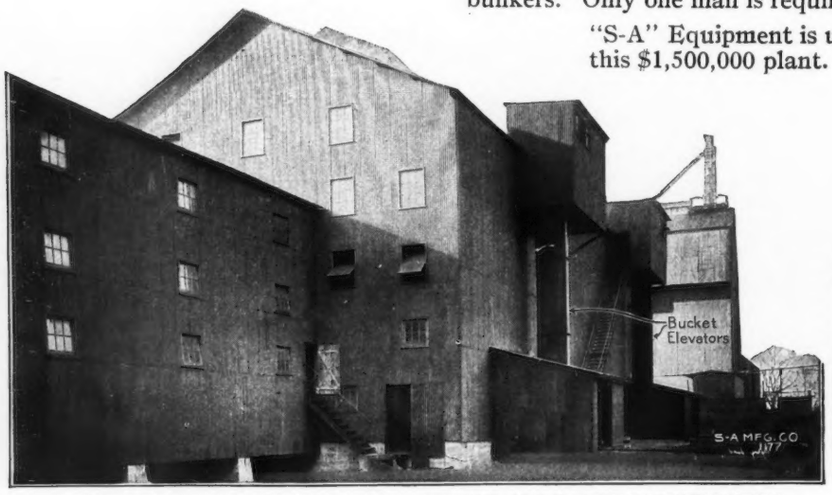

THE TWO ELEVATORS SHOWN DELIVER THE FINE ORE TO THE ROASTING KILNS

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Mining Journal

VOLUME 101 JANUARY 29, 1916 NUMBER 5

Jigs on a California Dredge

By Lewis H. Eddy*

SYNOPSIS—Regular mill equipment has never before been successfully used on dredging operations, but this plant makes use of Hardinge mills and Neill jigs. The saving is materially increased, thus introducing an important economy.

Eight improved Neill jigs and two Hardinge mills are in successful operation on Natoma No. 7 dredge in the American River field, near Folsom, Calif. The equipment consists of two units of four jigs and one mill each—one unit on each side of the dredge. The unit on the starboard side was installed in August and that on the port side in November, 1915.

The jig-and-mill equipment receives 60% of the total fines passing over the gold-saving tables. This amount includes the material formerly passed out as tailings. It has long been known that gold dredges, even of the most modern California type, have failed to recover all the gold contained in the gravel handled. The tailings loss was chiefly confined to the escape of greasy gold and flour gold.

The aggregate amount lost in the tailings in the past 15 years in the several dredging fields of California has been great enough to give rise to the belief that a large amount of dredged territory might be redredged at a profit. Numerous devices have been suggested and some of them tried out, but so far as known, the Neill jig and the Hardinge mill in combination form the only gold-saving equipment that has proved a commercial success in the recovery of gold from dredge tailings. The recovery by this process has already been proved to reduce the value of the tailings of No. 7 dredge to a negligible amount.

This jig was invented and patented by James W. Neill, Pasadena, Calif. (U. S. Pat. 1,144,495).[1] The original plan of mounting the paddle on a shaft extending through the center of the jig was discarded, and the plan of attaching the paddle to two arms connected with the operating rod was substituted, as shown in Fig. 3. This improvement was suggested by L. D. Hopfield, manager of the gold-dredging department, designed by E. E. Strouse, mechanical engineer, and approved by Emery Oliver, general manager, Natomas Company of California. The jigs were built by the Union Construction Co.

The jigs are situated in the sluices, and each jig receives all the material usually passing through two sluices. They are set in two rows and alternate, so that two have 12-ft. and two have 8-ft. connecting-rods. A shaft, 10 ft. 6 in. long, extends across the pontoon and is connected to the motor outside the housing. The pulsation in the jig is supplied by the paddle attached to two arms, one at each end, extending upward inside the jig and connected to the operating rod. The paddle arms are protected by casings inside the jig. The operating rod extends across the jig and is connected at the center, by a connecting-rod, to the eccentric shaft. The operating rod is provided with two downward extending arms, one on each extreme end. These arms extend outside of the end walls of the jig, the lower end of the arm fitting into castings attached to the outside of the jig, which form bearings, as shown in Fig. 1.

The jig screens are 8-mesh monel-metal wire, with a 1-in. bed of cast-steel shot, size BB. The screens are supported at three sides by projecting castings on the in-

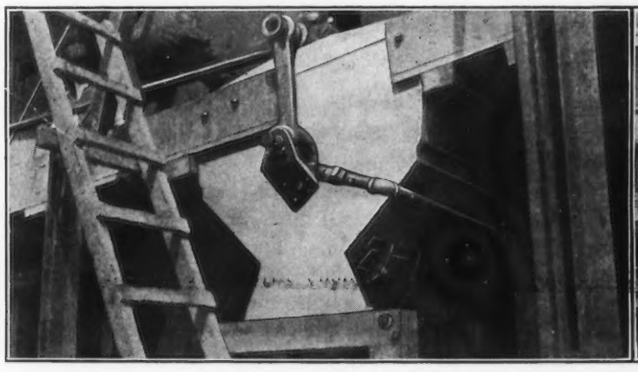


FIG. 1. OPERATING ARM AND ROD ON NEILL JIG

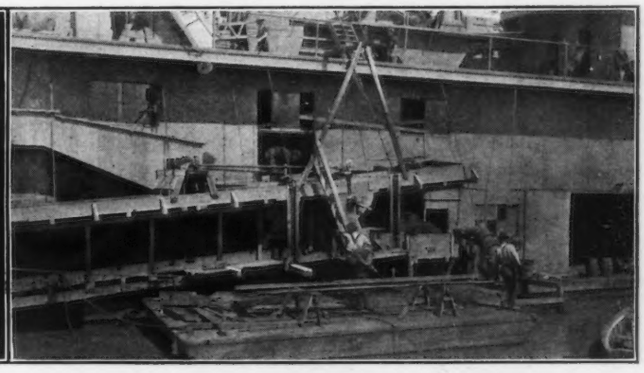


FIG. 2. INSTALLING EQUIPMENT ON STARBOARD SIDE

*Associate editor, San Francisco, Calif.

[1] "Eng. and Min. Journ.," Aug. 21, 1915, p. 313.

side walls of the jig and at the other side by projecting castings on the casings, which protect the paddle arms. The screen area is 2 ft. 5 in. by 3 ft. 8 in. The position of the screen frames is illustrated by Fig. 4.

Each jig unit is operated by a 15-hp. Westinghouse motor, each jig consuming approximately 2.6 hp. The

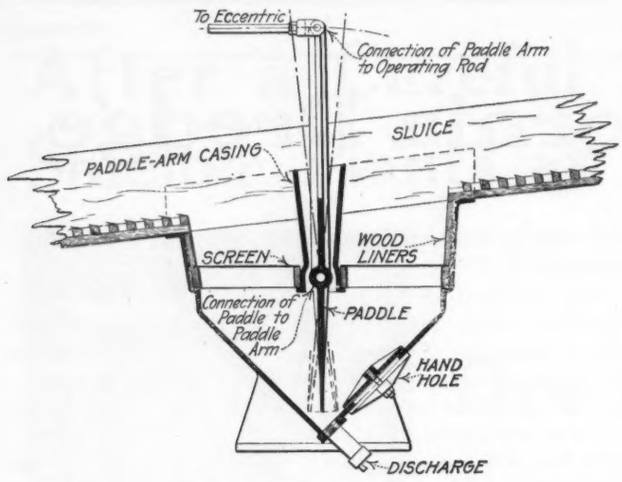


FIG. 3. THE NEILL JIG

Hardinge mill is operated by the same motor. The speed of the jigs is 172 pulsations per min.; speed of mills, 32 r.p.m.

Three jigs of each unit are situated outside of the housing, supported by the gold-saving tables, and one inside the housing, resting on the gold-saving tables. The Hardinge mill is a 4½-ft. size and occupies 7x9 ft. for-

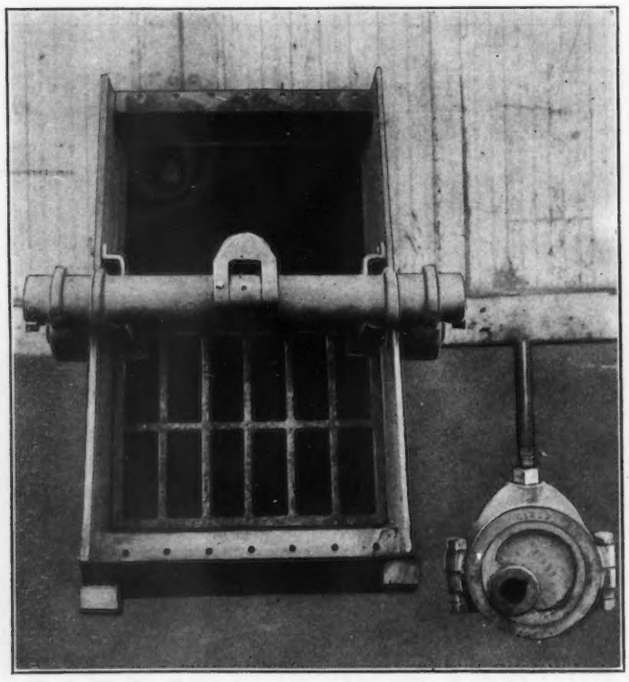


FIG. 4. LOOKING INTO TOP OF NEILL JIG; ONE SCREEN IN PLACE

ward of the jigs, about three-quarters on the pontoon, the remainder inside the housing. The jigs have constant discharge through 2-in. pipes, three from each jig, leading to a single launder connected to a receiving box for the Hardinge mill. A shaking amalgamator, 18x48 in., receives the discharge from the mill, and a wooden spreader, 5 ft. long, 18 in. wide at the upper end and 4 ft. wide at the lower end, receives the material from the shaking amalgamator and discharges to a 4x8-ft. silver-plated table. The spreader and table are situated inside the housing and alongside the jig equipment. The tailings discharge into a long narrow box leading outside the housing and to the pond. Fig. 4 illustrates the installing of the starboard equipment. Of the recovery obtained by the equipment, 97% is caught in the mill and shaking amalgamator and the remainder on the plates.

The cost of installation is comparatively low, and the added cost of labor amounts to the wages of three men, each working an 8-hr. shift. One man can take care of the two units, and although quite steadily employed during the shift, the work can easily be done by him with the occasional assistance of another of the regular employees of the dredge. In fact, the entire cost of installation, maintenance and labor is small compared with the results obtained by the recovery of the gold otherwise carried off in the tailings.

Report of California Industrial Accident Commission

SAN FRANCISCO CORRESPONDENCE

The California Industrial Accident Commission report for the fiscal year ended June 30, 1915, covers the departments of compensation, insurance and safety and is accompanied by full statistical data of 62,211 industrial accidents in the state during 1914. There were 678 deaths, 1,292 permanent injuries and 60,241 temporary injuries. A prior report covering the first 6 months of 1914 showed that 2,820 employers had filed with the commission written acceptances of the compensation provisions of the law; during the year ended June 30, 1915, additional acceptances to the number of 4,038 were filed, making a total of 6,858. These acceptances brought many thousands of employees under the benefit of the act creating the commission.

Five decisions of cases appealed from the awards of the commission were handed down by the Supreme Court sustaining the commission. The permanent-disability department rates permanent injuries according to the nature of the injury or disfigurement, the occupation and the age. This enables compensation to be awarded according to loss of earning power. California is the only state employing this method. The medical department arranges for examination and treatment of injured men in case of dispute as to the nature and extent of disability.

The insurance fund is reported to have been successful. At the close of the first year (1914) the fund had written $547,161 in net premiums. A refund of 15% of earned premiums was allowed to policy holders as policies expired and actual payroll expenditures were ascertained. The total amount of this refund was approximately $75,000. It is estimated that an additional refund of 28% will be made. At the end of the first year 1914 the rate schedule was reduced an average of 10%. From Jan. 1, 1914, to June 30, 1915, there were reported to the insurance fund 5,861 cases of accidental injuries; 37 of these cases resulted in death, 83 in permanent injuries and 5,392 were temporary injuries. Of the total, 349 were rejected. An exhibit was maintained at the Panama-Pacific International Exposition.

Inspectors visited 746 plants and caused the installation of safety equipment affecting 76,843 employees. Safety bulletins have been issued in English, Italian, Russian, Croatian, Spanish, Portuguese and Greek. A committee representing the California Metal Producers Association and organizations of mine employees, conjointly with members of the commission compiled mine-safety rules for the state. These rules have been issued in a book of 123 pages, pocket size. Coöperative agreement with the United States Bureau of Mines was continued. First-aid instruction was given the miners by Bureau of Mines engineers. Nearly all the mines of the state were visited and suggestions for safety generally adopted. Dredges were also visited and plans formulated for the safety of employees.

The accident reports for the year 1914 show that 678 workmen of an average age of 39 suffered death. About 48% of those killed left 625 persons totally dependent. The average age of women widowed through industrial accidents is about 39 years. These widows must provide for an average of 2¼ children each, of an average age of 9 years. Toward this provision the employers and insurance companies have paid a total of $243,366, and payments will continue for 4½ years from date of accident.

Nearly all conceivable forms of physical mutilation were suffered by 1,292 workmen; 31 men were sufficiently disabled to require life pension; 28 arms and 45 legs were amputated; 172 eyes were lost or suffered serious injury; 600 fingers were cut off. For the relief of these workmen $604,743 has been paid, and payments will continue. The 60,241 persons temporarily injured required the expenditure of more than $1,000,000 for their relief. The time lost on account of temporary injuries is equivalent to about 3,000 men being idle for the entire year.

Contact Sulphuric-Acid Patents

Considerable interest has been created by a notice recently sent out by the General Chemical Co., setting forth its ownership of certain patents said to be basic to the manufacture of sulphuric acid by the contact process.

Dec. 24, 1915.

Numerous inquiries having reached us of late as to the status of the contact patents for making sulphuric acid—some people appearing to think that the basic patents are about to expire—we have thought it best to answer all these inquiries by a circular letter to the trade, with a view to preventing loss to any who might be disposed to act in ignorance of the facts.

The basic patents in this field are the so-called Knietsch patents, which we purchased from the Badische Anilline und Soda Fabrik, of which the following is a list:

No. 652,119, dated June 19, 1900, for the process of regulating temperature, etc., expiring June 19, 1917;

No. 688,020, dated Dec. 3, 1901, covering among other things all apparatus for control of temperature, expiring Dec. 3, 1918;

No. 816,918, dated Apr. 3, 1906, for the process of absorbing sulphuric anhydride, which expires Apr. 3, 1923;

No. 822,373, dated June 5, 1906, for the purification of burner gases, which expires June 5, 1923;

No. 823,472, dated June 12, 1906, for repeated, successive or interrupted contact, or contact in installments, which expires June 12, 1923.

To appreciate the breadth and scope of these patents they should be read in full.

All the other patents (including certain of our own) are dependent upon these basic patents and utilize all or some of these in their operations. Consequently the expiration of any patents other than those enumerated will fail to enlarge the rights of the public or to justify the manufacture of contact acid without our consent.

Having paid a large sum of money in the purchase of these basic patents, having ourselves established the catalytic industry on a large scale in the United States and invested much capital therein, having licensees whose rights we are bound to protect and having caused our rights to be generally respected, we give notice that any person who may infringe upon any of the above-mentioned basic patents will do so at the risk of pecuniary loss and will be promptly prosecuted.

GENERAL CHEMICAL CO.,
Chas. Robinson Smith, Vice-President.
Thos. P. Burgess, Asst. Secy.

The contact-acid process has been of particular interest recently, owing to the high price of sulphuric acid, especially of the stronger grades, and many contact-acid plants have been planned.

El Oro District, Estado de Mexico, During 1915

EL ORO CORRESPONDENCE

The year 1915 was the most successful year in the history of El Oro Camp (from the standpoint of the bandit-revolutionist). The various mining companies have not fared so well.

January found the five principal mines—El Oro Mining and Railway Co., Ltd., Esperanza Mining Co., Mexico Mines of El Oro, Ltd., Cia. Minera Las Dos Estrellas, and La Lucha Mines—all mining and milling a limited tonnage, but with dynamite, cyanide and other supplies rapidly being exhausted, and with no prospect of any means of transportation for securing more.

The governor of the state of Mexico had been very insistent upon the operation of the properties in order to provide work for the natives and had promised governmental assistance in securing supplies; but the split between Villa and Carranza came early in December, 1914, and put an effective stop to the movement of freight, hence nothing could be done in the matter.

Occupation of El Oro by Blanco

Immediately after this break El Oro was occupied by the troops of Lucio Blanco, who had not yet decided which side to support. The arrival of the advance guard of this body was marked by pillage and robbery of many foreigners; under the pretense of searching for arms, horses were confiscated, and everything in the way of arms, ammunition, or equipment was taken from the foreigners. The stable men at the Mexico Mines were murdered when they could not deliver as many saddles as horses. After a few days' occupation of the camp, Blanco moved on and the Zapatistas entered.

Early in February, 1915, a small bunch of Gutieristas took the town after a spirited fight that centered about the Esperanza mill, but they quickly abandoned the place upon the appearance on Feb. 14 of 2,000 Zapatistas under Quintanilla. The great victory of taking the town had to be celebrated in true Zapatista fashion, so the town was given over to the wild Indians that composed the entire Zapatista army.

An orgy of murder, rape and pillage followed that would have done credit to Geronimo and his Apaches. Citizens were shot down in cold blood, women and girls violated, stores looted of their contents and one mining company robbed of its payroll. Numerous foreigners were maltreated and robbed, but none was killed. No effort was made by the officers to restain or control their men, save to see that they overlooked nothing; yet when the order was issued the next day stopping the looting, it was obeyed.

One bunch of Zapatistas arrived too late to share in the loot, so in looking for game they raided the Dos Estrellas mine and carried off several foreigners to hold for ransom, cruelly beating and otherwise maltreating them. By some unexplained good fortune, a woman, who was one of the Zapatista colonels, secured the release of the men after a day's detention. On Feb. 22, the Zapatista garrison had fallen off to about 400 men, and a body of Carranzistas under Amarro quietly surrounded the town and captured the garrison. During the fight the native inhabitants, who had been so shamefully used by the Zapatistas, took 225 of the garrison with what few weapons they had hidden, but mainly by knives, sticks and stones. Everyone was promptly killed in the most cruel manner. Quintanilla and his body-guard escaped.

Population of 20,000 Flees

The next day it was ascertained that the Carranzistas would withdraw should the Zapatistas send an army from Toluca, the state capital, so when on the 24th the garrison made ready to evacuate, the wildest disorder reigned, as no mercy was expected from the Zapatistas. Within 24 hours the town, normally of about 20,000 population, had been deserted by the natives, who went to the little mountain villages near-by, and only about 15 men, principally foreigners, remained. A train at midnight took the families of foreigners and the leading native employees of the mining companies to Maravatio, in Carranzista territory.

In the hopes of protecting the place, four Englishmen volunteered to go and see the Zapatista chiefs at Toluca, and four Americans likewise went through the Carranzista lines to get in touch with Villa. After several days' delay it was granted that no vengeance would be taken on the town or mines when the Zapatistas reentered the camp. The Carranzistas shortly afterward evacuated the place, taking with them the engines belonging to El Oro Mining and Railway Co., Ltd.

Mining and Milling Stopped

Naturally, when the town was evacuated by the inhabitants, all mining and milling stopped; and as supplies have practically all been consumed, there is no prospect of resumption of work until railway traffic is resumed. The mine pumps have been kept running, and a small amount of development work has been carried on, but no ore has been mined. The Zapatistas occupied the camp until October, when they were again driven out by Carranzistas, who still occupy the place.

During this last occupation by the Zapatistas, from March to October, the natives were in a sad state, on account of scarcity of food. The Carranzistas held all of the state of Michoacan, upon which the native population has to depend for corn and beans, their principal foodstuffs; and as the money of one party was not acceptable in territory controlled by the other, the situation was deplorable.

The mining companies then arranged with the Carranzistas to be allowed to bring food through their lines; so employees of the companies were sent to buy supplies and to pay for same with company checks on Mexico City banks. These checks are accepted by the farmer or merchant in preference to the paper money of either party, which is good only so long as the party issuing same is in control of the district, while checks are good for whatever money is valid in Mexico City on the day the check is presented for payment.

The Zapatista authorities—if it can be said that they ever had a semblance of a government—made capital of the conditions and filled their pockets at the expense of the camp. Their favorite stunt was to present an order to a mining company demanding a check for several thousand pesos in exchange for which they presented their paper money, declared by themselves to be the only legal tender, but in reality absolutely worthless. They always pretended that they were buying food for the destitute inhabitants, and under the conditions prevailing their orders could not be disobeyed. One does not try more than once to be diplomatic with a bandit who is careless how he handles his rifle.

The Revolutionists' Methods of High Finance

When the check had been secured, a trusty messenger was sent with it into Mexico City or Carranza territory, where it was cashed. Although the Carranza money was comparatively worthless, it was valued at two or three times the Zapatista paper, hence it could without difficulty be exchanged for Zapatista money at a good exchange. This Zapatista money was then presented to the mining companies with a demand for more checks. In the meantime the mining companies had been compelled to use the Zapatista money in paying their men, but the demands of the Zapatista officials soon placed in the hands of the companies an enormous quantity of their worthless paper, which they still hold, without any hope of ever receiving a cent for it.

The rumor that a bunch of Carranzistas was approaching always was a cue to the Zapatista officers to work another graft. A demand was at once made on the mines for 100 boxes of dynamite to destroy the railroad (as if it had not already been most effectively destroyed). Instead of blowing up tracks, the dynamite was shipped to the state of Morelos to use in little mines being worked by some of their officers.

As there was no authority in the district, robbery became the rule, and various raids were made on the mines and mills. La Lucha Mining Co. and the Esperanza Mining Co. suffered in this way to a large extent, the last-named company being robbed of bullion valued at over $30,000 United States currency. This bullion had been produced when it was thought safe to ship, but Mexican politics change over night and the Carranza-Villa break came before shipment could be made.

The plant was raided by an armed band that included many soldiers. One watchman was killed and two others were seriously injured by the bandits. Although employees of the company made arrests of several of the robbers and recovered part of the stolen bullion, the Zapatista officials allowed the prisoners to go free; and one general demanded the recovered bullion as evidence in the case, and when it was delivered to him, he took it with him to Morelos, where it was lost sight of.

The Tungchuan Copper Mines in Yunnan, China, are now operated by the government. The mines have been taken over by the Ministry of Finance, which obtains from them the metal needed for coinage of copper "cash." Sung Lien-Kuei is general manager at the mines. He is also in charge of the opening of a zinc-lead mine in Yunnan.

Stripping the Hillcrest Iron Mine with a Sand Pump

DULUTH CORRESPONDENCE

SYNOPSIS—Three essential conditions to successful hydraulic stripping operations: Kind of overburden suitable for hydraulicking; ample available water supply; suitable and convenient place for wasting overburden. Orebody stripped at Hillcrest mine 1,000 ft. long and 200 ft. wide; average depth of overburden, 65 ft. Pumping equipment consisted of one 12-in. two-stage centrifugal pressure pump, one 3- to 5-in. hydraulic giant and one 12-in. centrifugal sand pump; the last mounted on the body of a flat-car minus its trucks. The car body was lowered until stripping reached bedrock, when trucks were replaced, tracks laid and pumping outfit moved as desired. Electrical power used. Pump handled an average of 77,147 yd. per month.

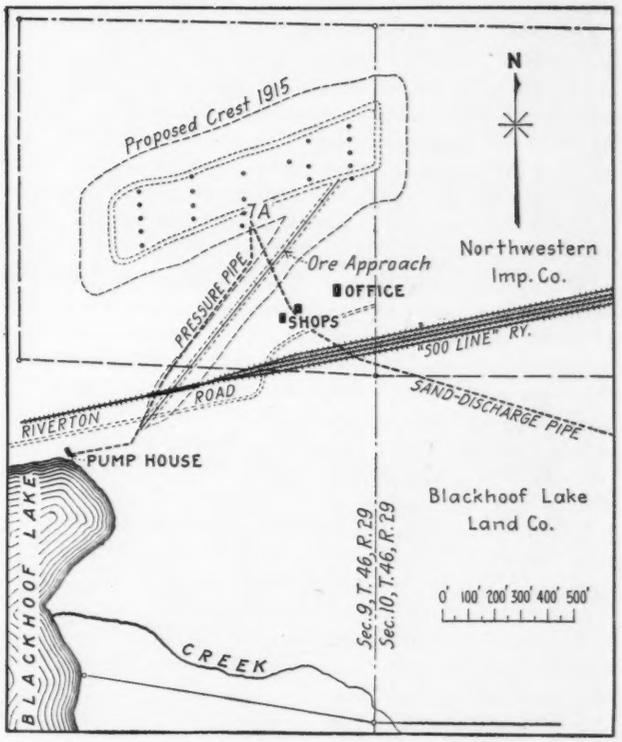
Using water to move dirt was probably first done when the original miner discovered that he could wash the sand out of a pan and recover the gold in the bottom. Using centrifugal pumps for the moving of sand and water is no new idea, as it has been employed in dredging silt and fine materials from the bottoms of streams and lakes for a great many years, for handling tailings in concentrating plants, and in many other fields that need not be enumerated. So far as the writer knows, the idea was first used for removing the high and dry overburden from an orebody in the phosphate fields of western Florida, where for years water has been pumped under pressure against a sand bank and the resulting emulsion of sand and water forced by centrifugal pumps up through a long pipe line to a disposal ground.

About three years ago it was discovered that a considerable amount of the overburden at the Rowe mine, at Riverton, Minn., could be washed off by simply turning a stream of water on it. With an installation consisting of a small pump and a hydraulic giant a considerable yardage was moved, and in order to uncover the ore completely, a sand pump, capable of lifting the sand and water emulsion up from a point lower in elevation than the disposal ground and forcing it through an ever-increasing length of discharge pipe, was installed. Eventually an installation of pumping units and a method of operation were adopted very closely following the experience of the Florida phosphate fields. The successful result of this operation guided the management of the Hill Mines Co., of which Roger R. Hill, of New York City, is president and managing director, in deciding to use a similar method in removing the overburden from the Hillcrest mine at Ironton in the same district.

The data following were furnished by Wilbur Van Evera, of Virginia, Minn., who, as consulting engineer, recommended this method, planned the work in detail and later, as manager of mines for the company, carried out the plans to the present development.

There are three equally essential conditions necessary to a successful hydraulic-stripping operation, as follows: A kind of overburden suitable for handling by this method; a readily available and ample water supply; a suitable and convenient place for wasting the overburden removed. An important but secondary consideration would be electric power at reasonable rates. This consideration, however, has more to do with the first cost of equipment than with the operating expense and consequently is not an essential.

In judging the character of the overburden the management was guided by the exposures at the Rowe mine pit 2½ mi. west of the Hillcrest and at the Pennington mine pit ¾ mi. to the east of it, by a careful study of the drilling records, and the experience of the drill runners, who sank casings for 44 drill holes in the area to be stripped. The conclusion reached, that the overburden consisted



MAP OF HILLCREST HYDRAULIC STRIPPING OPERATIONS

mainly of fine sand with but little heavy gravel, boulders or clay, has been justified by the results of the work.

The water-supply was Blackhoof Lake, a body of water about one mile long and one-half mile wide, in one corner of the property.

The disposal ground was 80 acres of swamp land at a level only slightly above that of the lake and with a drainage back to it. Over this it was possible to waste a layer of stripping about 12 ft. in thickness, without reaching a static head for the sand-pump discharge greater than 52 ft., or a length of discharge pipe greater than 2,000 ft.

The power was supplied by the Cuyuna Range Power Co. from its plant on the Crow Wing River.

The orebody at the Hillcrest mine, which it was decided should be stripped, is approximately 1,000 ft. long and 200 ft. wide, with an average depth of overburden of 65 ft. Allowing for 20 ft. berms, 1½-to-1 slopes and an approach, the yardage to be moved amounted to a little over 1,000,000 cu.yd.

The equipment purchased was: One 12-in. centrifugal sand pump, direct-connected to a 300-hp. motor; one 12-in. 2-stage centrifugal pressure pump, direct-connected to a 250-hp. motor; 1,200 ft. 14-in. flanged spiral-riveted pipe; 500 ft. 12-in. flanged spiral-riveted pipe; 2,600 ft. 12-in. bolted-joint connection spiral-riveted pipe; one hydraulic giant; one second-hand flat-car; electrical accessories, wire, valves, pipe-line fittings, tools, etc. The total cost of the listed equipment amounted to $12,000 in round figures.

Sand Pump Requirements

The sand pump purchased was designed to deliver 4,200 gal. per min. against 146 ft. total combined static and friction head, and to do this required a 40-in. diameter runner driven by a motor at a full-load speed of 505 r.p.m. Owing to the fact that the sand pump would first be operated at surface elevation against a negative static head of 7 ft. through 2,000 ft. of pipe line, it was necessary to provide against overloading the motor by using a smaller-sized pump impeller to start with and by using a motor with a 50% speed reduction. The alternative to this arrangement was a belt-connected unit, with which the varying conditions could be met by using pulleys of different diameters to vary the speed of the pump.

The pressure unit consisted of two simple volute 12-in. pumps with a motor between and direct-connected to each of them, the discharge of the pump on one side being connected over and across to the suction of the pump on the other side. This 2-stage unit was designed to deliver 4,000 gal. per min. against 170 ft. head. This gave a nozzle pressure at top ore level of from 70 to 80 lb., depending on the size of nozzle used. The hydraulic giant was of the common California type and was provided with nozzles ranging, by ¼-in. variations, from 3- to 5-in. diameters. The electric motors were 2,200-volt slip-ring type alternating-current units.

The record of the operation is best detailed by reference to the map showing the layout of the pit, water-supply and disposal ground. The pressure pump was placed on the shore of the lake and the pressure line laid over to the proposed approach and up the line of the approach to the proposed pit. The sand pump was placed at drill hole 7*A*, on the south edge of the orebody and at a point which the top ore contours showed to be a slight depression. The proposed layout included an undercrossing of the Soo Line tracks, and to accomplish this, piling for a bridge was driven before operations were started and the bridge was built before any dirt was moved. The first work was to run a sluicing-cut under one end of this bridge and through the hill just above it, in order to lay the pressure line on an even grade. Fig. 1 shows this cut from the Soo Line bridge, looking northeast toward the proposed pit.

At the location of the sand pump six 6-in. pipes were sunk through the surface and 10 ft. into the ore, a total distance at this point of 65 ft. These pipes were handled with a drill outfit like ordinary drill-hole casings and were spaced in a rectangle 15x20 ft. Heavy clamps were put on them and three 12x12 timbers braced with hog rods laid on the clamps. The deck of a flat-car laid on these timbers was the platform on which the sand pump and motor, switchboard and resistance grids were mounted. Six 3-ton duplex chain blocks, hung from the steadying braces clamped to the top of the 6-in. pipes and hooked into stirrups in the 12x12 cross-timbers, were used for lowering the platform.

Work of assembling and setting up the machinery was started Mar. 1. A pumping sump was excavated on the shore of the lake, and 200 ft. of a penstock was run through a shallow muskeg bottom, out into the lake, to lead the water to the pumping sump. It was found necessary to drive 26-ft. piling to a solid bottom for the pressure-pump foundation, and this was done with the company's own drill outfit. Owing to delays in receiving the machinery, which was ordered for delivery Mar. 1, it was not possible to start up till late in April. Fig. 2 shows the start of the sand-pumping operation Apr. 26. It also shows very clearly one expensive mistake—the 14 ft. of 12-in. suction hose. After a four days' trial, during which it was possible to get just 20 hr. of actual operation out of it, it was in the condition shown in the illustration. Before any progress at all could be made, this had to be removed and the suction shown in the subsequent illustrations installed. Fig. 2 shows the six 6-in. pipes upon which the pump platform is supported and the details of the clamps, cross-timbers, top braces and chain blocks; also the gate valves in the suction and discharge lines. The gate valve had to be removed and a foot valve at the end of the suction substituted. The latter was removed as soon as the pump was lowered so that the water column of the discharge line was standing against the pump.

Method of Lowering Pump Platform

The pump platform was lowered about 3 ft. at a time. As soon as the dirt was washed out about 3 ft. below the clamps, the cross-timbers supporting the pump platform were raised with the chain blocks just enough to take the weight off the clamps; the clamps were lowered on the pipes and the chain blocks slackened away until the cross-timbers again rested on the clamps. As the pump was lowered the pipes were unscrewed at the top and removed. This operation was repeated until the pump had been lowered 26 ft. on May 8. The condition of the pit at that time is shown by Fig. 3. At that time it was found that the pump shell was wearing badly. As there were no prospects of getting repairs for it for six weeks, it was decided to rest at that level to avoid the wear on the shell, which increases very rapidly with an increase in pumping head. On receipt of repairs for the pump, lowering was resumed on June 12, and by June 28 the suction was on the ore. The total time consumed in lowering the pump 52 ft., or until the suction was on the ore, was 22 days, excluding the time when the condition of the pump would not permit of lowering.

Fig. 4 shows the method of widening the pit. Fig. 5 shows the pumping plant, on July 15, three weeks after the pump had been lowered to the bottom of the stripping pit, also the upper bench, where the pump rested and the pit was widened during the time repairs for the sand pump were awaited. The layer of dark material at the bottom of the bank is a very tight boulder clay, at some points grading into a genuine hardpan. It was difficult to break this material up even with a nozzle

FIGS. 1 TO 8. SCENES SHOWING THE VARIOUS STAGES OF PROGRESS DURING THE HYDRAULIC STRIPPING AT HILLCREST IRON MINE

stream at 80 lb. pressure, and in some instances it was necessary to blast it, notably in preparing a sump for the suction when lowering and in getting the first channels through it to the north side of the pit. Practically all of the boulders shown in Fig. 7, lying in the bottom of the pit, came from this layer, which fortunately pitched down and disappeared as the work progressed toward the north side of the pit.

Fig. 7 shows the approach to the pit, on a 3% grade and Fig. 8 shows the end of the sand-pump discharge line and the kind of material that can be handled by the pump.

At its first location (that is, at the point where the 6-in. pipe standards were sunk) the pump was operated till Sept. 8, moving approximately 340,000 yd. of material. At that time it seemed advisable to dig the approach, or rather, at this stage of the operation, the "exit" from the pit. This was the most difficult part of the work, as it was necessary to ditch a level channel for 700 ft. to get into the approach at a point on the final grade line, and this was mainly through the layer of tight boulder hardpan already referred to.

Change to Moving Pump-Platform

The first move was to replace the trucks under the flat-car deck that had been used for a pumping platform and set a section of rails under the trucks. Then by setting up the nozzle about 250 ft. in front of the pump, it was possible to drive the gravel and boulders toward the pump until there was a dead-level ditch in which track was laid and the pump car moved up. The pump was originally placed under the X, Fig. 7. It was moved straight east 250 ft., then turned and moved due southwest in two settings, along the line of the approach to the location at which it is shown in this illustration. From there out the approach was washed to the permanent 3% grade through heavy gravel and boulders. Because of the heavy gravel encountered in this cut, one more move was necessary to complete the remaining 750 ft. of the approach.

The subgrade had to be 23 ft. below construction at the Soo Line undercrossing. The Soo Line built the bridge on piling driven below the proposed approach grade line, and all of the dirt was moved with the nozzle and washed back to the sand pump. The crossing was built and completed without constructing a run-around and without a minute's delay to the ore, freight and passenger trains that passed here all summer long.

With the completion of the approach, about Nov. 1, the permanent approach track was laid and the sand-pump car was rolled down into the pit, straightened around and clamped to the rails, to remain in that position until the remainder of the overburden at the east end of the pit is removed, or until cold weather stops the operation. The approach track is complete behind the sand-pump car, and when the freezing weather becomes too severe to permit further operation, it will be but half a shift's work to pull the entire equipment up high and dry into the railroad yards.

The average monthly yardage during the time the pump was operated in the pit was 77,147. The average during the time the approach was being washed was 54,707 yd., and the average for the entire six and a fraction months of operation up to Nov. 1 was 69,834 cu.yd. per month. As the hardest part of the work is over—and by this the digging of the approach, the lowering of the pump platform, the experimenting with different kinds of pump shells and various devices are referred to—the balance of the dirt should be removed at a rate that should materially increase this average.

The yardage performance of this unit is shown by the following figures:

Month	Cu.Yd.	Actual Time, Hr.	Min.	Yards per Hour	No. of 12-Hr. Shifts	Hours per Shift	Yards per Shift	Solids, %
April ..	11,000	77	47	145.0	..	....	....	....
May	85,423	540	39	158.0	54	9–55	1582	16.4
June ...	59,728	497	45	120.0	54	9–12	1106	14.8
July ...	68,195	550	30	124.0	58	10–21	1275	13.0
Aug. ...	95,539	639	50	149.0	60	10–31	1592	13.2
Sept. ...	52,633	428	30	122.8	43	9–53	1224	10.7
Oct.	56,781	435	20	130.4	47	9–12	1208	10.7
	429,003	3160	21	135.7*	..	10–18*	1397*	13.2*

*Average.

The operating force necessary for this unit consists of six men on each shift: One pumpman at pressure pump, one pumpman at sand pump, one suction tender, one nozzleman, two helpers. These men work 12-hr. shifts, one crew remaining on shift till the other crew comes out. The nozzleman acts as boss of his shift and is paid 30c. an hour. The other men receive 25c. an hour. In addition to the regular crew there is a general foreman, a clerk, a blacksmith, a teamster and a helper, or a total of 17 men on the payroll.

Items of Operating Costs

The largest single item of cost is the power. At the Hillcrest mine current is delivered to the switchboard at 2,200 volts for 1.19c. net per kw.-hr. The average actual running time is 20 hr. 36 min. per day, and the cost of power for this average is about $90 per day. This item will of course vary with the lift and distance that the sand must be pumped and to a great measure with the pump efficiency, which decreases rapidly after the pump begins to wear out. Repairs and renewals are a small item. Owing to the difficulty of obtaining repairs for the original pump, it was discovered, before the pump had been in operation three weeks, that it would be necessary to make other arrangements for renewals. Accordingly, with the aid of Frank Zimmerman, mechanical engineer for the National Iron Co., of Duluth, a new pump was designed and patterns made. The new design not only doubled the life of the pump and increased its efficiency, but reduced the cost, and by reason of the patterns being kept close at hand in Duluth, prompt deliveries could be made that were utterly despaired of from the foundries in the East. This one thing was a great consideration in this case, since without it a continuous operation would have been impossible. The experience of this operation has been that it wears out about one pump (consisting of a shell, suction head and runner) a month, at a total cost of $375.

The question naturally arises as to how closely the bottom of the pit can be cleaned up. Fig. 6 shows one portion of the pit where the hydraulic work has been practically completed. Here the sand-pump suction is on the ore. Under the north bank, where the end of the nozzle stream strikes, there remains about 12 ft. of soil. In the judgment of the Hillcrest management, this remaining wedge, consisting largely of boulders and hardpan, can be more advantageously handled by a steam shovel than by the present hydraulic method.

The possible application of this method of stripping at other mines or in other districts is a point that should

be considered. On the north Cuyuna Range the overburden is generally adapted to the hydraulic method. There are now five pits on the north range and in each one of them the material exposed could be handled easily by the equipment here described. There are then only the questions of water-supply and disposal grounds to be considered in this district. On the Mesabi Range the overburden would not generally be adapted to this method. However, the muskeg swamps, usually underlain by a loose gray sandy clay which every Mesabi Range miner has seen a steam shovel wallowing in at various times, could be handled advantageously by a sand pump. At the Hillcrest mine, as noted, the total time required to lower the pump 52 ft. to the ore was 22 days, and when this was accomplished there was a great inverted cone of a pumping sump that thoroughly drained the surface for hundreds of feet around it. The suggestion is offered for what it is worth, that such a sump as this could be rapidly and cheaply sunk at the beginning of many Mesabi Range stripping operations and save the very expensive and discouraging job of beating the water down with steam shovels or the expensive alternative of sinking a shaft toward the rather doubtful end of draining the surface through it.

Zero Weather Does Not Halt Work at Hillcrest Mines

The hydraulic process of stripping orebodies in use at the Hillcrest iron mine on the Cuyuna Range is being put to its severest test by operation under sub-zero temperatures and during the past few days has demonstrated that it can be successfully used in winter as well as at other seasons of the year. Present prospects are that stripping operations will be continued during all of the present winter at the Hillcrest mine.

One day recently the pumps were operated with the thermometer registering a temperature of 26 deg. below zero, and while some heroic efforts were necessary to keep ice from forming in the pipes, the task was successfully accomplished. The water passes through the pipes at a speed of 12 ft. per sec. but despite this, ice began to form in the pipes and operatives were kept busy dislodging it through the day and night. In ordinary temperatures of winter this trouble is not experienced and now it is thought that it will not be necessary at any time during the winter to stop operations.

Gas Explosion in Cuban Mine

Mention was made recently of the death of Bryan K. Morse, on Jan. 12, as a result of a gas explosion in an old copper mine in the province of Pinar del Rio, in western Cuba. Mr. Morse was in charge of the exploration work of El Informador Minero, of Havana, Cuba, and was unwatering the old copper mine near Bahia Honda. Some further details of the accident are now at hand, and it may be of interest, as well as benefit to others contemplating similar work, to have the information conveyed in a recent letter from one of Mr. Morse's friends in Pinar del Rio. The mines in this part of Cuba are normally not gaseous, but it is worthy of note that two men lost their lives from an explosion of gas—evidently generated in this instance by decomposing organic matter that had remained in the mine since its earlier exploitation. On Jan. 11 Morse with four others entered the mine to explore an old "gallery" that had been under about 200 ft. of water for more than 12 yr. This working had been unwatered to within 2 ft. of the bottom, and as the men proceeded the stench from the water was too strong for three of the men, who returned toward the shaft. Morse and one man proceeded for about 30 ft. to where the gallery opens out, when the explosion came. The rush of air knocked down the three men who had returned toward the shaft, but as soon as practicable they went back to the gallery and pulled Morse and the miner from under the fallen timber. Both were badly burned, but alive. Morse also had a broken leg. They were taken to Bahia Honda, the miner dying on the way. Morse died the next afternoon, about 24 hr. after the accident.

Australian Metal Exchange

Early in July, 1915, the Federal Attorney General of Australia made a statement to the effect that the channels through which Australian metal products found their way to British and neutral markets were still dominated by German influence and that the Allies were being bled of millions of money in order to secure the necessary munitions. This led to the creation of the Australian Metal Exchange under government control. The exchange was officially opened in both Sydney and Melbourne in November. The principal rules, which have been drafted by committees representing Melbourne and Sydney, embrace certain fundamental principles for safeguarding Australian interests and developing the metal industry of the commonwealth, some of which are as follows:

No person shall be eligible as a member, active or associate, of the exchange unless he is a natural-born British subject and domiciled in the commonwealth.

No person shall be eligible as an active member unless he is engaged in the commonwealth in producing, buying or selling, or treating, or refining metals or minerals, or is the nominated representative of a British firm or British company so engaged. The definition of British firm or British company is given, and the attorney general of the commonwealth may, at his discretion, grant a certificate of eligibility to any person, firm or company who may not comply with the rule. A renewal of such certificate may be obtained annually.

Exchanges have been established in Sydney and Melbourne, and as time goes on, doubtless will be in the capitals of other states, but a "branch exchange shall be subject to the rules and regulations of the Australian Metal Exchange." Practically the most important rules are those dealing with sales and contracts.

All sales and purchases of metals or minerals except refined noble metals (unless exempted by the attorney general of the commonwealth) for export or for consumption beyond the commonwealth shall be registered by an active member of the exchange with the registrar.

The registration shall set forth truly the name of the real buyer, the name of the real seller, the price and the port or ports of destination. Sales or purchases of metals or minerals not exceeding a value of £500 for consumption in Australia shall not require to be registered.

It may be provided by the regulations that sales or purchases of metals or minerals exceeding a value of £500 for consumption in Australia shall be registered by an active member of the exchange.

Shipments of metals or minerals which to the knowledge of the shipper may be unsold at the time of shipment shall be registered, together with an undertaking that the name of the real buyer and the price will be registered within 48 hr. of the receipt of advice of the sale of the whole or any portion of the shipment.

It shall be a condition of every contract that if the attorney general notifies in writing to the registrar his disapproval of the buyer within 48 hr. after being advised of the contract, the contract shall be void; but his approval shall not be necessary to buyers included in any list approved by him.

Underground Mining Methods of Utah Copper Co.*

SYNOPSIS—The underground mining system of Utah had to be such that it would not interfere later with steam-shovel work on the surface, and yet should extract the ore cheaply while it was being used.

The mining property of the Utah Copper Co. is situated in the West Mountain mining district, Salt Lake County, Utah, in the Oquirrh Range of mountains. The Utah Copper mine is primarily a steam-shovel operation, but up to April, 1914, a considerable tonnage of ore was obtained by underground-mining methods, since most of the shovels were working in capping, and it was necessary to keep the mills at Garfield running at capacity.

Realizing that underground mining was to be but an incident in the mining of the orebody as a whole, a system of stoping was adopted which would not affect adversely future steam-shovel operations. In order to fulfill this requirement it was essential that the surface should not be caved, that no large openings be left unfilled and that capping should not be mixed with ore.

The system, as finally adopted and successfully operated, consisted in starting stopes on three separate levels, or tunnels. The first of these tunnels, driven 7x7.5 ft. in the clear, was the main or motor-haulage level. The second, 150 ft. vertically above the main level, was equipped for hand tramming only, so all drifts, crosscuts, etc., were driven 5.5x6.5 ft. in the clear. The third, 100 ft. vertically above the second, was also a hand-tramming level and driven 5.5x6.5 ft. in the clear. These three levels were connected by many manways and raises for dropping the ore from the upper tunnels to the motor-haulage level. An underground shaft, centrally located and equipped with a compressed-air hoist, was used to hoist supplies from the motor-haulage level to the upper levels, but no ore was handled through it. Each level had one or more surface connections affording good natural ventilation to all parts of the workings (Figs. 1 and 2).

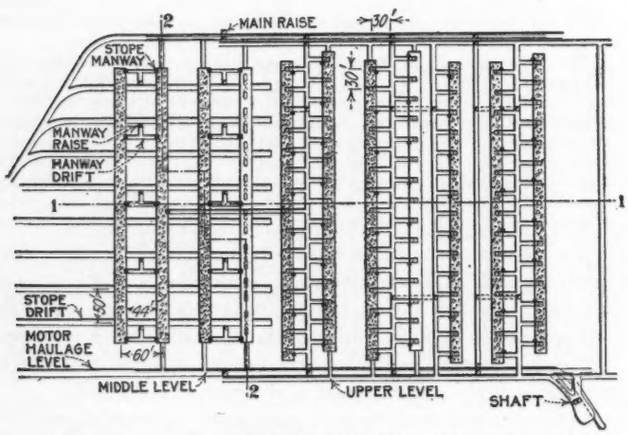
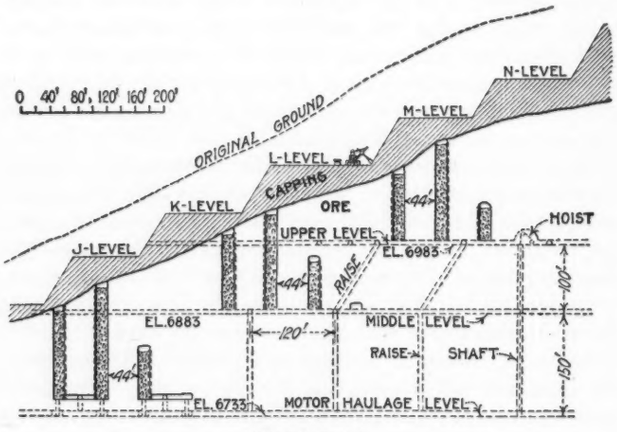


FIG. 1. PLAN OF WORKINGS FOR ONE BLOCK OF STOPE



SECTION 1-1

FIG. 2. SECTION SHOWING RELATIVE POSITION OF STOPES TO STEAM-SHOVEL LEVELS

By means of these three levels the orebody was divided into blocks for stoping. The central block, 500 ft. wide (see Fig. 1), was bounded on the main level by two parallel motor drifts and on the upper levels by two main parallel tramming drifts directly over those on the haulage level. At intervals of 120 ft. along these motor drifts, raises 5x6 ft. were put up on a 55° pitch to the level above and afterward extended to the third level.

In order to make the stopes as safe as possible, to minimize the amount of timber required and to leave substantial walls for the safety of future steam-shovel operations, it was decided that the standard width of stope should be 16 ft., with 44-ft. pillars between stopes.

Main, or Motor-Haulage, Level

The method of starting stopes on the motor-haulage level was somewhat different than on the upper levels, although the size of stopes and pillars was the same.

Motor drifts were driven on the motor-haulage level, spaced at 50-ft. centers and parallel to the main drifts forming the boundaries of the block. At intervals of 60 ft. along these drifts the surveyor marked the center of the stopes as the drifts were driven; if the ground required timbering, the tunnel sets were spaced to be suitable for stope-chute sets later on. After the stope-chute sets were completed, a man with a stoping machine drilled both sides directly over the chutes, nearly horizontally and on the center line of the stope, to form a pocket at this point. The next round on each side pointed strongly upward, and from that point on, the raise was extended on a 60° pitch until the face was 31 ft. vertically above the top of rail. The stoping machine was then taken out, a No. 9 Leyner machine set up near the top of the raise and a drift started each way. These drifts were run horizontally, following the center line of the

*Originally presented at the annual meeting of the Utah Section, A. I. M. E., Salt Lake City, Oct. 1, 1915, by Thomas S. Carnahan, Bingham Cañon, Utah, and published in the January "Bulletin."

stope, and were made 8x8 ft. Since their maximum length from any ore chute was only 18 ft., little shoveling was necessary to get the ore to the chute. After this drift was completed for the full length of the stope, the Leyner machine took 4 ft. off each side of the drift, to bring the stope to the standard width of 16 ft. The ore broken in all this work was drawn from the chutes, so that when this stage of operation was completed, there was an excavation 450 ft. long, 16 ft. wide and 8 ft. high ready for stoping operations.

Chute timbers were arranged as follows: Three tunnel sets of 12x12-in. timbers were set up, spaced at 5½-ft. centers (see Fig. 3); posts 8 ft. long were set in hitches cut in the floor deep enough to make the bottoms

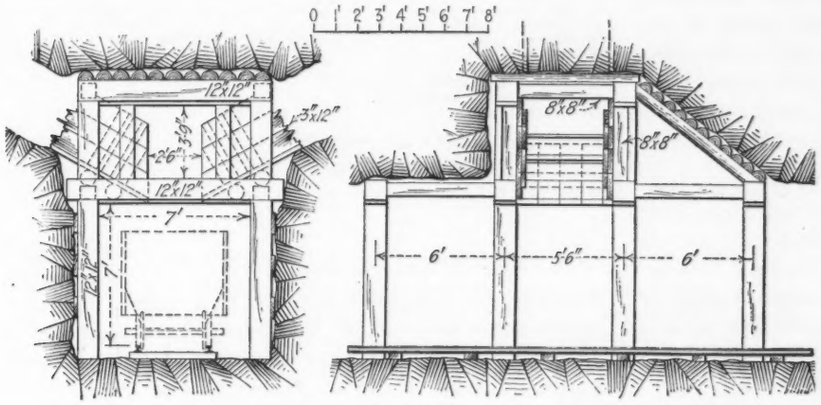


FIG. 3. STOPE-CHUTE TIMBERS ON MOTOR-HAULAGE LEVEL

of the caps 7 ft. above the top of rail. Caps were cut 10 ft. long, so as to extend 6 in. beyond the side of each post and blocked tightly against the walls. Planks, 2x12 in. by 7 ft. long, nailed under the cap, acted as spreaders for the posts, but no sills were used. The sides were lagged with 2x12-in. planks. Enough ground was then broken above the tunnel sets to make room for a short set. The posts for this set were cut 3 ft. 9 in. long of 12x12-in. timber. Only two short sets were put in, one on each side of the chute mouth, the top and sides being lagged with split round poles.

The Manway Raises and Drifts

In alternate drifts, that is at intervals of 100 ft., manway raises were put up in the pillars, midway between the stopes. The raises were started in offsets 6 ft. from the center of the track, and driven on a 50° pitch. They were made 4x6 ft. and divided into a chute and a manway by means of stulls and 3x12-in. planks. The manways were equipped with ladders and the chutes with gates, so that the ore broken in the raises could be loaded directly into motor cars.

When the manways reached an elevation 31 ft. vertically above the top of rail, manway drifts were started both ways at right angles to the raises, or parallel to the motor drifts. The bottoms of these drifts were 25 ft. above the top of rail, or on a level with the bottom of the stopes. These drifts, at 19 ft. from the manways, broke into the sides of the stopes. At the junction of the drifts with the stopes, 8x8-in. sills 8 ft. long were laid 3 ft. in the stope and 5 ft. in the drift and 6x6-in. cribbing built upon them, dapped 1 in. so as to leave a space of 4 in. between cribbing. The crib timbers were 4 ft. long, making the manways 3x3 ft. in the clear. The cribbing on the drift side was left off for the first 5 ft. to form an entrance into the manway. The manway timbers projected 2 ft. into the stope and 2 ft. into the pillar, thus placing them in solid ground on parts of three sides. After the manways were thus completed to within a few feet of the back of the stope and equipped with air lines, the stopes were ready for active stoping.

Stoping Crew and Their Task

Usually, in working a stope, a crew consisting of a machine man and a pickman worked from each manway, so that ordinarily five machines were working in each main-level stope. Stoping was done on but one shift a day, so the same crew was responsible for conditions at a given manway. The pickman trimmed down the back of the stope so as to make it safe for the machine man. In a shift of 8 hr., each stope crew was expected to put in from 14 to 20 holes, 6 ft. deep, depending on the ground, and load and fire them. A round of 15 holes ordinarily broke 150 tons. The motor crew on the following shift pulled about 75 tons, representing the swell of the ore, so that the stope crew would have sufficient room to work on top of the broken ore. The ideal condition for efficiency and safety in a stope was to keep the top of the broken ore within 9 ft. of the back of the stope. With five machines in a stope, a separate crew of crib men was employed to build the manways and keep them at all times well above the level of broken ore in the stope. The stopes from the main tunnel were carried to capping, or abandoned 10 ft. below the second level if the ground above

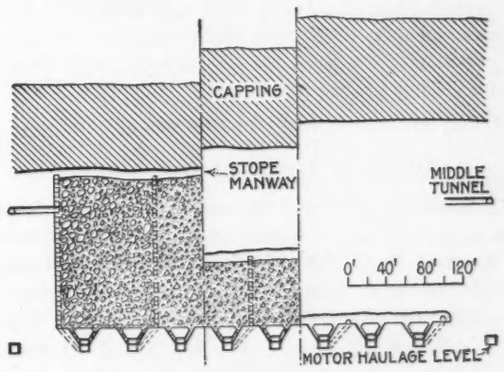


FIG. 4. SECTION SHOWING THREE STAGES OF STOPES FROM THE MOTOR-HAULAGE LEVEL

the second level had already been stoped. As soon as a stope was abandoned, the chutes were nailed up so that no more ore could be pulled from them (Fig. 4).

As mentioned, the upper levels consist of main drifts directly above the motor drifts forming the limits of the stope blocks. Crosscuts were driven every 120 ft. at right angles to the main drifts; that is, parallel to the center line of the stopes. These were driven on a 1% grade from each main drift, meeting in the center of the block. Each crosscut was connected to the main-haulage level by two raises which came out in the floor of the crosscut 100 ft. from each of the main drifts. On both sides

of these crosscuts stope drifts were driven at 30-ft. intervals, for a length of 30 ft., or 11 ft. beyond the center line of the stopes. They were then enlarged sufficiently to accommodate the timbers for stope chutes.

The chute timbering consisted of three tunnel sets spaced at 4½-ft. centers, except in every other drift, where an additional set was put in at 3½-ft. centers to accommodate the manway. Tunnel sets were of 10x10-in. timbers, with posts cut so as to leave 7 ft. between top of rail and bottom of cap. Collar braces were of 8x8-in. timbers or round poles not less than 7 in. in diameter. Caps for manway sets were 11 ft. long to form the sill for manway cribbing. The chute lip was 3 ft. 9 in. above the top of rail and was made of 3x12-in. plank. Chutes were equipped with two gates so as to control the flow of ore easily. Tops and sides were lagged with 2x12-in. plank, or split round poles (see Fig. 5).

Means of Stope Preparation

After the stope-chute timbers were in place, the ground above the timbers was drilled with a stope machine; but before blasting, the top was lagged with short split round poles, so that the ore could be loaded directly into a car without shoveling. An 8x8-ft. drift was then started on top of the chute timbers with the center line of the stope as one side of the drift, and extended the full length of the stope. Later this drift was widened to 16 ft.

Manways were put up in every second stope drift, of the same dimensions and material as the manways from the main level, and carried to the third level, or to capping if struck before the third level was reached. Where the distance to capping was greater than 100 ft. but less than 200 ft., connection was made with the stope on the third level, the old manways were abandoned and new ones started from the third level. Where the ore thickness was greater than 200 ft. above the second level, stopes were started from the third level, run to capping and abandoned before the stopes from the second level were started.

Order of Working the Stopes

In a given block it was the custom to have the stopes on the top level worked out considerably in advance of those started from the middle level. In this way the upper stopes were abandoned before those from below began to disturb the tramming drifts and stope manways. This was necessary also to avoid cutting off the raises through which the ore was dumped from the upper to the main-haulage level, before the upper stopes were worked out. For the same reasons the stopes started from the middle level were kept well in advance of those started from the main level (Fig. 6).

On the middle and upper levels all ore was hand-trammed from the stope chutes to the nearest raise. The raises were so spaced that the maximum length of tram was 150 ft. and the average 90 ft. for all stope ore. Tracks for hand-tramming were 18-in. gage, laid with 16-lb. rails and a grade of 1% in favor of the loaded cars. The stope crosscuts were double-tracked for short distances near the raises, to permit several cars to run to the same raise without delaying or interfering with one another. Tram cars measured 2x2.5x4.6 ft. in the clear and held about 1 ton of porphyry ore. Two trammers were used on a car, and the average tonnage trammed by each crew from a stope was about 65 tons per shift. A tallyman, stationed at each active stope, credited each car dumped to the proper crew.

DATA FROM AN AVERAGE MONTHLY STATEMENT

Month of August, 1912:		
Tonnage from stopes		112,990
Tonnage from development		8,026
Distribution of Labor		
Stopes	Number per Day	
Machine men	41	
Pickmen and helpers	41	
Trammers	87	
Cribmen (stope manways)	11	
Timbermen (stope chutes)	11	
		191
Development work:		
Machine men	28	
Muckers	32	
Timbermen	4	
		64
General:		
Trackmen	6	
Timbermen	4	
Motor crews	12	
Foremen and shift bosses	8	
Engineers and samplers	4	
Miscellaneous	29	
		63
Surface men:		
Blacksmiths, etc.	5	
Gravity tramway	20	
Common labor	6	
Miscellaneous	9	
		40
Total		358
Average daily tonnage per man		10.9 tons

During the 3-year period, 1911 to 1913 inclusive, 2,824,439 dry tons of ore was drawn from stopes at a cost of 56.6c. per ton loaded in railroad cars at the ore bin. In addition, 102,719 ft. of development work yielded 247,280 dry tons at a cost of $4.95 per foot of development, or $2.05 per ton of ore. As the development was carried on entirely in average grade of ore, it about paid for itself from the ore broken. Counting every item of expense, the cost of producing a ton of ore from all sources by underground mining averaged 68.7c. By the system in use, with 16-ft. stopes and 44-ft. pillars, less than 27% of the ground developed was actually stoped, and as the stopes were full of broken ore when abandoned, the actual production represented less than 50% of the ore broken or about 13% of the ore blocked out by the development work. The cost of production would have been considerably less if the pillars could have been mined and the broken ore in the stopes pulled. Manway drifts and raises, and stope drifts were charged direct to stoping, all other drifts and raises being charged to development.

COST OF DEVELOPMENT WORK

	Per Foot
Motor-haulage drifts (7x7.5 ft. in the clear); No. 9 water Leyner used (progress 5 ft. per round):	
Drilling and mucking	$3.50
Powder, caps and fuse	1.25
Compressed air	.30
Miscellaneous	.55
Total	$5.60
Timbering (not always necessary)	1.61
Total	$7.21
Tramming drifts (5.5x6.5 ft. in the clear); 2.5-in. piston machines used (progress 3.8 ft. per round):	
Drilling and mucking	$2.25
Powder, caps and fuse	.68
Compressed air	.21
Miscellaneous	.47
Total	$3.61
Timbering (not always necessary)	1.35
Total	$4.96
Raises (4x5 ft. in clear); hammer machines used (progress 5 ft. per round):	
Drilling and tramming	$1.50
Powder, caps and fuse	.85
Compressed air	.15
Miscellaneous	.90
Total	$3.40

All development work was contracted at the following rates for breaking and mucking, not including timbering, the company furnishing the supplies:

Motor drifts (7x7.5 ft. in clear), $3.50 to $4 per foot (depending on whether dry or wet ground).

Tramming drifts (5.5x6.5 ft. in clear), $2.25 to $2.50 per foot (depending on length of tram).

Raises (4x5 ft. in clear), $1.20 to $1.80 per foot (depending on length of raise).

At these rates, the contractors were able to make from $3.75 to $5 per shift, depending on the ground and their own efforts.

DISTRIBUTION OF MINING COSTS

	Per Dry Ton
Labor	$0.329
Powder, caps and fuse	.091
Timber	.049
Motor haulage	.025
Gravity tramway	.020
Supervision and engineering	.038
Compressed air	.024
Miscellaneous	.111
Total	$0.687

These figures include every item of expense incident to the mining of the ore, including the necessary development work. Under the head of miscellaneous is included the proper proportion of all general expenses, such as taxes, insurance, Salt Lake and New York office expenses.

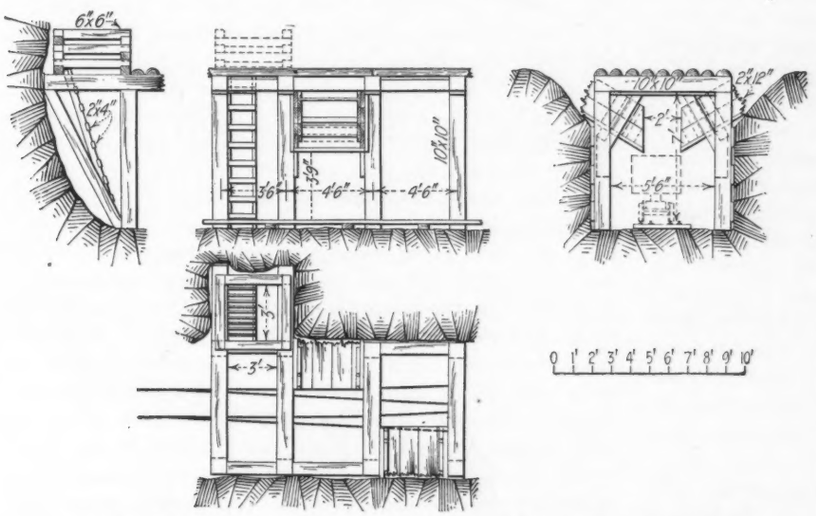


FIG. 5. STOPE-CHUTE TIMBERS ON HAND-TRAMMING LEVELS

Drills and Water Supply

For all large drifts, such as motor drifts and stope drifts, and for widening out stopes, No. 7 or No. 9 Leyner water drills were used, the smaller machines being used only in soft ground. For small drifts the one-man 2.5-in. piston machine, of both Ingersoll and Sullivan makes, was used, while hammer drills were used for raising and stoping.

In the principal drifts and crosscuts on each level a 1½-in. pipe line was laid to supply water for the Leyner machines and for fire protection. A reserve supply of water was stored in tanks erected in a drift 50 ft. above the top level, the head being sufficient to carry the water to all parts of the workings. As the two upper tunnels were dry, it was necessary to fill the storage tanks by pumping from the ditch on the main-haulage level, a small compressed-air pump, operated an hour or two each day, being used for the purpose.

The main-level track is laid with 60-lb. rails, 36-in. gage, and a ¼% grade in favor of loads. The General Electric 10-ton locomotives, each pulling a train of seven cars, or 60 tons of ore per trip, have handled as high as 4,000 tons in a shift of 8 hr., the average being 2,500 tons. Loading from a chute in which the ore runs freely, a train could make a round trip in 15 min., as follows: Loading train at ore chute, 2.5 min.; trip to ore bin (4,000 ft.), 5; dumping train at ore bin, 2.5; return trip to chute, 5; total, 15 min.

As the portal of the motor-haulage tunnel is on a hillside at a vertical distance of 350 ft. above the level of the railroad yard and at a horizontal distance of 700 ft., a surface gravity tramway is utilized to transport the ore to the yard. Two Stein trams were installed and were so arranged that they can be operated singly or both at the same time.

The surface incline has 60-lb. rails and a 36-in. gage, with an inclination varying from 30° at the top to 18° near the bottom. At the level of the motor-haulage tunnel a 300-ton ore bin gives sufficient storage to assure no delay to the motor trains. The gravity-tram skips are loaded from this bin through air-lift gates. At the bottom of the incline a circular steel ore bin of 2,000 tons' capacity gives sufficient storage to avoid delay in the operation of the tram even if railroad cars are not furnished for several hours at a time.

The skips on the gravity tram have a capacity of 12 tons and dump directly into the steel ore bin through doors in the bottom of the skips. Railroad cars are loaded from the steel ore bin by means of air-lift gates, only 4 min. being necessary to load a 70-ton car. One engineer at the headhouse of the gravity tram can easily lower 4,000 tons of ore over this tram in a shift of 9 hr. The brakes on the drums of these trams are tightened by dead weights, and released when the weights are raised by compressed air. When the supply of compressed air fails, the brakes are automatically applied, eliminating any danger of a runaway.

The system of stoping as practiced was eminently satisfactory to supplement the steam-shovel operations without injuring the ore reserves of the property through a mixing with capping. All ore produced was absolutely free from waste, since both stopes and development drifts were discontinued when capping was reached. The assay value of the ore produced could be regulated and

COST OF OPERATING GRAVITY TRAMWAYS

At capacity of 3,000 tons in 9 hr.:		Cost per Month
Labor:		
Tram engineer	$135.00	
Loaders at bins	525.00	
		$660.00
Supplies:		
Compressed air	$13.50	
Miscellaneous	14.00	
		27.50
Repairs and renewals:		
Labor:		
Repair man	$82.50	
Miscellaneous	12.00	
		94.50
Supplies		60.00
Total		$842.00
Cost per ton		$0.0094

the tonnage materially increased or decreased without affecting to any extent the cost per ton.

As many engineers have gained the false impression that a system of mining involving the use of shrinkage

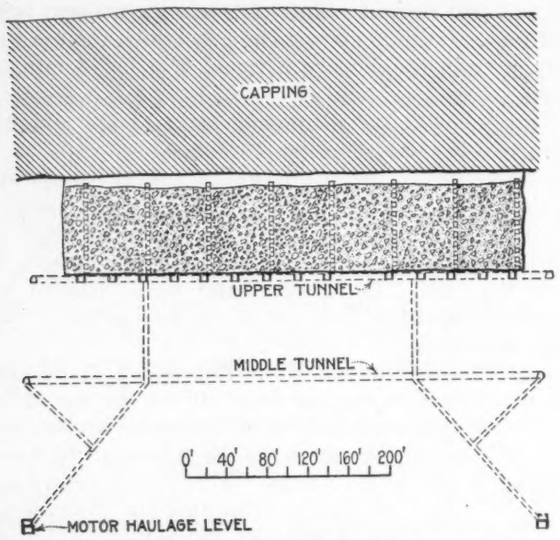


FIG. 6. SECTION SHOWING A STOPE STARTED FROM THE UPPER LEVEL, AND RAISES THROUGH WHICH THE ORE IS DROPPED TO MOTOR-HAULAGE LEVEL

stopes is necessarily hazardous, a list of the fatal accidents during the three years under discussion may be of interest. The following is a complete list of fatalities for a three-year period during which time more than 3,000,000 tons were mined at a cost for timbering of less than 5c. per ton:

	Number of Fatalities
In stopes:	
Falling rock	3
Other workings:	
Falling rock	1
Man fell into ore chute	1
Electrocuted	1
Asphyxiated	1
Total	7

Most of these accidents were entirely due to the carelessness of the men injured. A noteworthy feature is that not a man was fatally or seriously injured through the use or handling of explosives.

California Mine-Safety Work

The mine-safety work of the Industrial Accident Commission of California has been carried on in the past two years under a coöperative agreement with the United States Bureau of Mines and directed by H. M. Wolflin, one of the mining engineers of the bureau, occupying the position of chief inspector. Mr. Wolflin has been promoted to the position of mine-safety engineer in the Bureau of Mines and will be stationed at Pittsburgh. He was succeeded in January, 1916, by Edwin Higgins. Mr. Higgins has been in the position of mining engineer in the Bureau of Mines for the past three years as inspector of metal mines, stationed at Ironwood, Mich.

During the two-year period of Mr. Wolflin's incumbency, practically all of the larger mines in the state have been visited twice, and some of them oftener, for the purpose of investigating safety conditions and making recommendations to improve these conditions. During this period mine-safety rules were prepared by a committee composed of three mine operators, three miners and a representative of the Accident Commission. These rules became effective Jan. 1, 1916.

In general, the attitude of the mine operators has changed from one of hostility to one of coöperation, where the safety work is concerned. Although the suggestions that were made have not been rigidly enforced, they have in almost all cases been carried out, because of this spirit.

Deputy Mine Inspectors Are Civil-Service Employees

State civil-service examinations were held for applicants for positions of deputy mine inspector. G. Chester Brown, who had been temporarily appointed Mar. 20, 1915, was permanently appointed July 16; J. Wesley Gebb was appointed July 12, and F. L. Lowell Sept. 1. Since their appointments these engineers have been in the field most of the time, assisting with the safety work. Mr. Brown has visited the mines of Amador, Calaveras, Tuolumne, Shasta, Trinity, Siskiyou, Lake, Sonoma, Napa and Solano and some of those in Kern, San Benito and Inyo Counties, besides giving partial first-aid training to 243 men. Mr. Gebb has visited the mines of El Dorado, Placer, Nevada, Sierra, Plumas, Butte, Modoc and San Luis Obispo Counties. Mr. Lowell has visited some of the mines of Inyo, San Benito, Kern, Tulare, Fresno, Madera, Marisposa and Tuolumne Counties, besides making some special investigations and giving partial first-aid training to 50 men.

United States mine-rescue cars Nos. 2 and 5 have visited the mines which they could reach from the railways and have given training in mine-rescue and first-aid work. Training has also been conducted on a coöperative basis between the commission and the Bureau of Mines, by A. A. Krogdahl, George W. Riggs and S. C. Dickenson. As a result 868 men have received training in first-aid work and 66 in mine-rescue work. During September, 1915, a National Mine-Rescue and First-Aid Meet was held in San Francisco. This was financed by the California Metal Producers' Association, arrangements being made by committees appointed from among mine operators and others interested, as well as from the staffs of the Bureau of Mines and the Industrial Accident Commission. There was also held a California State First-Aid Meet, in which nine first-aid teams and one mine-rescue team participated. This was the first state meet held in California, although during the past two years two first-aid meets have been held in the Mother Lode region.

Coöperation Will Continue To Be the Watchword

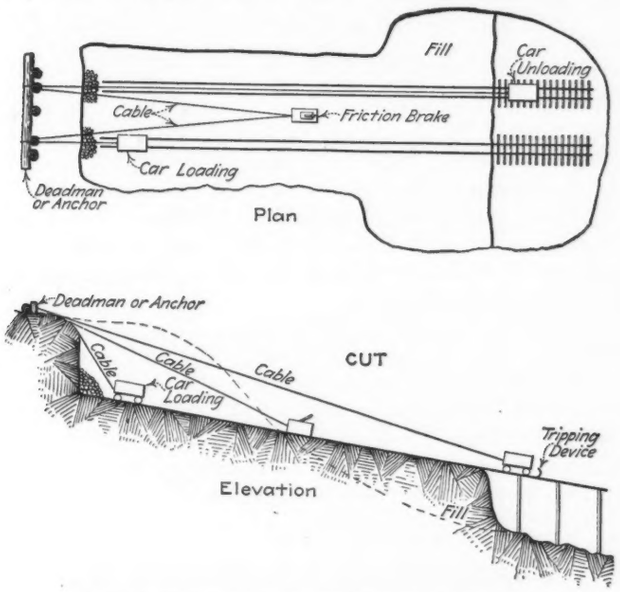
Mr. Higgins states that he is in hearty accord with the policy established in the effort to lessen the dangers connected with all classes of mining work and believes that a further reduction in the hazards of mining in California can be accomplished by an equitable administration of the mine-safety rules and a continuation of the coöperation of operators and miners. Through the activity of Mr. Wolflin there has been accumulated in the office of mine inspector a large amount of data referring to safety methods and devices. Mr. Higgins brings with him an additional supply of material of this kind, collected in various mining districts of the United States. This information, except such as is confidential, will at all times be available to mine operators of the state.

Details of Practical Mining

Jigback Used in Constructing an Incline

By Frederick W. Foote*

A "jigback" is a balance gravity-operated tramming system that permits the approach of cars right up to the working face. One of these, of the type described, was used recently in the construction of an incline and was found to be very successful. The cars used are of the self-dumping type, the dump being accomplished by a guide outside the track. The lever to open the end of the car runs up on this guide and thus causes the end to open and the material to run out. A Chinaman assists any reluctant pieces and spreads out the carload and



SIMPLE JIGBACK FOR CONSTRUCTION WORK

looks after the lower section of track. The speed of the car is regulated by a brake, of the friction-clutch type, operated by a man who watches the upper portion of the track and in his spare time assists in mucking.

Above the cut is anchored a "deadman," to which two blocks are attached. This "deadman" is usually a log anchored behind two stumps. A continuous cable extends from one car through the block at the "deadman" down with a couple of turns around the brake drum and up through the other block and then down to the other car. This cable is fastened permanently to one of the cars and is provided with an adjustment at the shackle of the other car to permit of its being lengthened as the work progresses.

This jigback was used for a haul up to 1,000 ft. and can be operated as fast as 1,000 ft. per min., but care must be taken to keep the track straight and in good order to prevent derailments. The brakeman must also use care in stopping the car, so that the cable will not be broken or the lower car go over the dump or the upper one smash itself into the muck pile. With a little practice, however, the required degree of proficiency is attained.

*Mining engineer, City Point, Va.

Compressed Air or Electricity in Mine-Stope Haulages*

In many mines of the Eastern Rand a large number of power winches are employed in stopes and winzes, acting as feeders to the main haulage road. Their work is generally intermittent and often confined to clearing loose rock from the working face at the beginning of the shift. In such cases the over-all economy of electric power is more or less questionable and requires investigation in any given case. The following comparative conditions have to be considered: (1) Relative consumption of air and electricity corrected for transmission losses (and in the case of electricity probably for transformation losses); (2) relative maintenance cost; (3) relative first cost, including supply pipes or cables.

The efficiency of an electrically driven winch can be estimated from the over-all efficiencies of the motor and gearing. To arrive at the quantity of air used by an air winch in the performance of a given amount of work, the method adopted in practice was to haul, at a definite speed, a given load up an even incline of a length and gradient representing the average of the mine—actually 235 ft., with a 10° slope. The difference between the air pressure at the winch and at the main compressor was then taken to arrive at the transmission losses, and the whole result converted into terms of cost per ton wound. The horsepower developed is 21.2 and the cost of air, 0.193d. per ton handled. To arrive at the cost of energy supplied to an electric winch working under the same conditions, developing 2.12 hp., the efficiency of the gearing and motor (15 hp. continuous rating) is taken at 85% and 87% respectively, or an over-all efficiency of 74%. The efficiency of transmission and transformation between the point of purchase on the surface and the working point underground is taken as 95%; under these conditions the cost per ton handled is 0.033d. In other words, the air winch costs five or six times more for power to run than the electric. This result is quite what one would have suspected, but, as will be seen later, by no means covers the whole ground.

Turning to the item of repairs and maintenance, experience with 60-odd air winches in one mine gave a cost of maintenance wages, averaged over many months, of £2 12d. per week per month. It was impossible to obtain figures of a similar scale for electric winches, but general opinion appears to be that they are on a much lower scale. As regards first cost, the average price of the electric winch appears to be slightly higher than that of the air-driven machine; but the electric winch has a greater overload capacity.

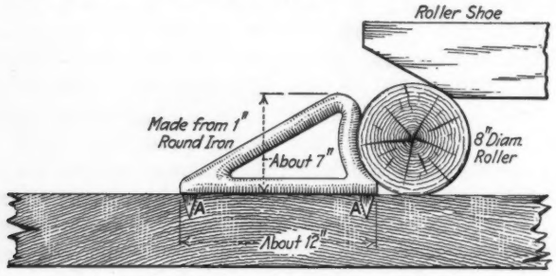
*From paper read before the South African Institute of Electrical Engineers, by A. E. Middleton.

The crux of the question, however, lies in the matter of supply pipes and cables. Air has to be carried long distances to the working faces, and the extra length and cross-section of air pipe required at any point for a winch is practically negligible. On the other hand, apart from pumps and haulages generally situated on the main arteries of the mine, no electric power is available, and the cost of extra cabling has to be debited *in toto* to the electric winch. As an example of this large expenditure, it was recently estimated for the mine referred to, in which 60-odd air winches are in use, that not less than 32,000 ft. of cable would be required, although the mine is already equipped underground for electric pumps and haulages. In all cases where the tonnage handled is considerable, the extra cost of cabling can be spread over a satisfactorily short length of time, to make its use attractive. On the other hand where long lengths of cable have to be laid and the tonnage is small, the economy is doubtful.

Summing up, one may say that although a considerable field is open for electrically driven winches in the flat mines on the Eastern Rand, the heavy cost of cables is the chief adverse factor against their adoption. It must be borne in mind that the losses of an underground compressed-air system from radiation and leakage are very large.

Roller Dog for Draglines

In dragline work, where the tracking is bad or where the rollers and roller platforms are wet and muddy, it is almost impossible at times to make the rollers catch under the skids or roller shoes. It often happens also



ROLLER DOG SET FOR USE

that the skids, owing to a poor roller, will settle lower than the diameter of the next roller. A successful method of holding the rollers is practiced by Don B. Hearin & Son, St. Patricks, La., according to the *Excavating Engineer*.

A pair of dogs is made of 1-in. round iron, as shown in the sketch. Each dog is about 7 in. high and 12 in. long, and at each end has a sharp spike, or sharp-pointed lug (see *A* in sketch). By means of these spikes the dogs are driven into the section timber at each end of the roller. This successfully holds the roller in place until the machine has moved ahead far enough for the roller to get well under the shoe. The dog is then easily and quickly removed. One pair only of these dogs is needed for each dragline excavator, and they are both cheap and effective.

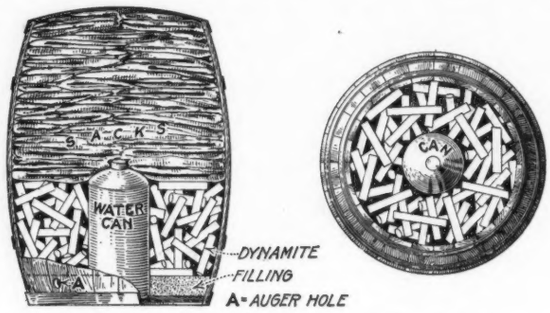
Nonfreezing Explosives Are Possible. They do not, however, contain any nitroglycerin and are only adapted for work in a limited field. Nothing has yet been discovered as a mining explosive which equals one of nitroglycerin base, either in shattering or breaking power, stability or regularity.

Home-Made Thawing Kettle

The following method of thawing powder is described by J. H. Carse, in the *Du Pont Magazine:*

First: Secure an old barrel of some kind. Bore one or two ½-in. auger holes in the bottom. Place a little straw, hay, sawdust, or anything that will allow water to filter through easily, to a depth of about 2 or 3 in. in the bottom.

Second: Secure an old oil can capable of holding at least 5 gal. A round one is preferable, because it will be more convenient to pack dynamite around it. This can



SAFE HOME-MADE POWDER THAWER

should have a closed top. Fill the can with boiling water and place it in the center of the barrel on top of the 2- or 3-in. filling. The purpose of the ½-in. auger holes in the bottom of the barrel is to allow any water to drain out that might accidentally be spilled. In case the weather is not very cold, the can of hot water should be wrapped in a sack to prevent the dynamite from coming in direct contact with it.

Place the dynamite around the can in such a manner that the heat can circulate about the cartridges easily. After a sufficient quantity is thus placed, fill the rest of the barrel with sacks or anything convenient which will retain the heat. A 5-gal. can of boiling water is sufficient to thaw at least 50 lb. of dynamite.

This method is safe and convenient.

Ventilating a Long Drift*

At the Morris-Lloyd mine of the Cleveland-Cliffs Iron Co., four miles west of the City of Ishpeming, Mich., a drift on the 600-ft. level was driven a distance of 2,960 ft., beginning at a point 350 ft. from the shaft.

At a distance of 1,220 ft. from the shaft, a fan station 12x14 ft. was cut, and a No. 10 Buffalo Forge Co. steel pressure fan of 20,000 cu.ft. per min. capacity installed, capable of operating either as a suction or a blower. This was operated by a 240-volt 15-hp. direct-current motor, taking current from the underground haulage wires. Ten-inch riveted steel pipe was connected to this fan, one end being kept about 75 ft. from the breast, the other discharged into the pipe compartment of the shaft.

After a blast the fan was started as a suction from the breast, and at the same time a small jet of compressed air was allowed to escape in the breast. The compressed air forced the smoke and gases down the drift to the suction end of the fan pipe. Without this compressed air blowing in the breast, it was found that some of

*Excerpt from paper delivered by J. E. Hayden, mining engineer, Cleveland-Cliffs Iron Co., Ishpeming, Mich., at Lake Superior Mining Institute, September, 1915.

the smoke and gases got by the suction end, which was placed on the rib line at a height of 6 ft. from the floor. After 15 min. of operation as a suction, the fan was reversed, and fresh air blown in the breast, when work could be resumed with safety.

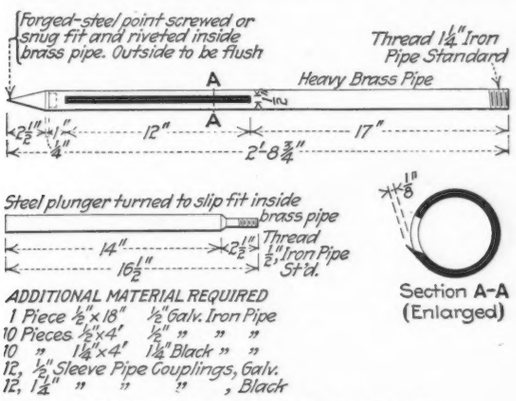
No artificial ventilation was used in the 1,220 ft. of drift up to the fan station. As most of this work was done during the cold weather when the shaft was strongly up-cast, the blowing of air in the breast was sufficient to clear the drift in 30 min.

A Tailings Sampling Device*

An auger for taking samples from depths not exceeding 8 to 10 ft. that could be used for sampling dry tailing dumps, comprises the following material:

One 1½-in. Snell ship auger with screw. Upset stem, cut off to 18 in. over-all, and thread upset end for ⅜-in. standard pipe.
One length ¾x6-in. galvanized pipe. Thread both ends.
Four lengths ⅜ in. by 2-ft. galvanized pipe. Thread both ends.
Two lengths ⅜x3-in. galvanized pipe. Thread one end.
Eight ⅜-in. galvanized-iron sleeve couplings.
One ⅜-in. galvanized-iron tee.
Two 8-in. Cochran or Stillson pipe wrenches.
All pipe threads to be cut full standard depth, rubbed free from slivers and heavily greased.

The tee with the two 3-in. lengths of pipe forms a handle for turning. In use the auger is shoved down, without turning, to the elevation from which a sample is


Forged-steel point screwed or snug fit and riveted inside brass pipe. Outside to be flush
Thread 1¼" Iron Pipe Standard
Heavy Brass Pipe
A
A
12"
17"
2'-8¾"
Steel plunger turned to slip fit inside brass pipe
14"
Thread ½" Iron Pipe St'd.
16½"
Section A-A (Enlarged)
ADDITIONAL MATERIAL REQUIRED
1 Piece ½"x18" ½"Galv. Iron Pipe
10 Pieces ½"x4' ½" " " "
10 " 1¼"x4' 1¼"Black " "
12, ½" Sleeve Pipe Couplings, Galv.
12, 1¼" " " " , Black

SHAW'S SPECIAL SOIL SAMPLER

desired, a few turns are made with a slight pressure on the stem and the auger is withdrawn. The single worm auger specified has been found especially satisfactory in retaining samples, which may be obtained with ease from muck, clay or sandy clay soils. By careful manipulation and some experience, sand samples may be secured from moderate depths; but thick strata of sand, especially where water is present, cannot be sampled satisfactorily with an auger.

Special Sampler for Deeper Borings

In making deeper borings, a more elaborate device is employed. This is illustrated by the accompanying cut. In use the steel plunger is screwed to the 18-in. length of ½-in. pipe and slipped to the bottom of the brass "core barrel." Brass pipe is used for taking the sample, as it runs true to bore and an accurate fit of plunger may be secured. The instrument is forced down into the ground and successive lengths of the 1¼-in. and ½-in. pipe added until the desired depth is reached, when the plunger is withdrawn far enough to insure clearing the slot cut in the core barrel. In soft material the suction resulting from a sudden withdrawal of the plunger will cause the barrel to fill to the top of the slot, but in harder material it is necessary to rotate the larger pipe by using a pipe wrench, the lip on the brass pipe shaving off a sample. Care should be exercised to see that the slot is fully covered by the plunger until ready to take a sample; otherwise the exact location from which the sample is taken will be in doubt.

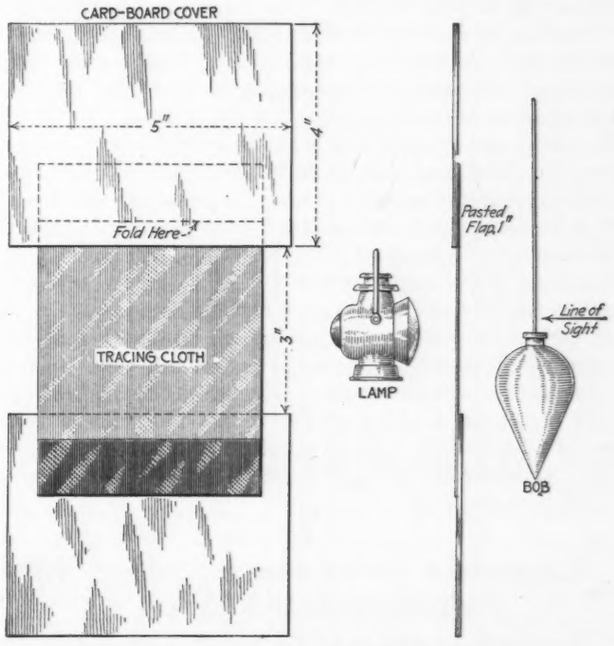
By providing a short length of 1¼-in. pipe with a driving head, a moderate amount of driving may be done to pass through hard strata. Black-iron pipe is specified for the outer casing as it is stronger than galvanized pipe and less likely to break off at the joints. Samples have been taken from a depth of 40 ft. with a device of this nature. This equipment may be secured at almost any well-stocked machine shop at a cost of $15 to $20.

*By Arthur M. Shaw, consulting engineer, Hibernia Building, New Orleans, La., in "Engineering News," Dec. 23, 1915.

Plumb-Bob Illuminator

By R. K. Warner*

The sketch shows a device used by me in surveying, which has several advantages for illuminating the plumb bob in distant sights. It is made from two pieces of cardboard and a piece of tracing cloth, pasted together



NOVEL PLUMB-BOB ILLUMINATOR

as shown in the sketch. The weight of the cardboard cover keeps the cloth taut when sighting, and when not in use the device folds up compactly and can be carried in an ordinary notebook. It is easily made, convenient to carry, and gives a good sight because the cloth does not get dirty or wrinkled.

Righting the 17-Cu.Ft. No. 2 Dredge of the Canadian-Klondyke Mining Co. and rehabilitating it cost the company $150,000, according to Lord Brabourne, who presided at the annual meeting of the Granville Mining Co., the parent company. Canadian-Klondyke No. 2 dredge overturned on Oct. 10, 1914, and was placed in commission again on Sept. 21, 1915, an accident while on the ways causing a delay in the relaunching.

*Wanakah Mining Co., Box 501, Ouray, Colo.

Details of Milling and Smelting

West Australian Stamp Practice

Stamps are used for crushing at the Sons of Gwalia mill in West Australia. According to T. B. Stevens, in the *Monthly Journal* of the Chamber of Mines of West Australia, Sept. 30, 1915, the weight of the stamps as originally erected was only 1,000 lb., and the mortars were wide and roomy, having been designed for inside amalgamation. Since larger tonnages have been required, the weight has been increased by using larger bosses and stems. The weights of the various parts as increased are: Boss, 340 lb.; shoe, 245 lb.; stem, 510 lb.; tappet, 130 lb., making a total of 1,225 lb.

The camshafts are 5½ in. in diameter, the size of the original installation, but they seem to be too light for the increased stamp weight. Broken shafts, if they show no flaws when heated, are welded at the mine, the two broken ends are cut off square and then bored and a dowel fitted before the welding is done.

Further to facilitate crushing the internal dimensions of the mortars have been reduced by fitting wooden liners faced with steel. Shoes are made of forged steel of the usual pattern, but a deviation from usual practice is the use of cast-iron dies made at the mine foundry. They are 4 in. thick and last 30 days. Owing to the low cost of the cast-iron dies, they can be frequently renewed and it is found that a more constant tonnage can be crushed on account of the more even surface maintained under the shoe. When worn down to 2 in., the dies are returned to the foundry and recast at a trifling cost.

Mortars are set on wooden piles and have withstood the extra weight added to the stamps remarkably well. During 15 years of continual use no repairs have been required except occasional leveling of the tops. The screens used are of 22-gage wire with an aperture of 0.097 sq.in. The ratio of water to solids is 4.75:1, and the stamp duty is 10 tons per day.

Cyanide Process Applied to Antimonial Ores

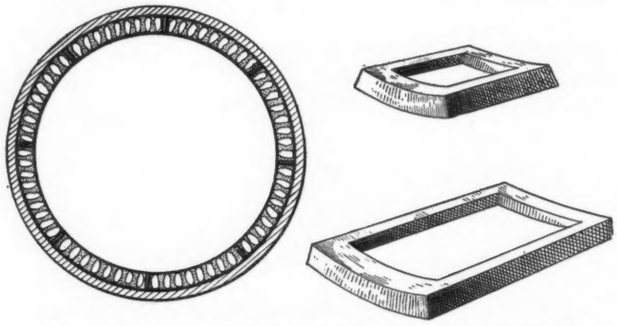
The reported discovery by MacArthur, Forrest & Co., of Glasgow, of a simple and, it is claimed, a reasonably cheap process of dealing with the antimony-gold ores of the Murchison Range, Transvaal, has attracted a great deal of attention in South Africa. It consists in dissolving out the antimony sulphide, or stibnite, from the crushed auriferous ore by means of a heated solution of caustic soda and its recovery as a clean salable product, together with the separate treatment of the leached sands in order to obtain the gold.

According to the *South African Mining Journal* it is carried out at the United Jack mine as follows: The ore from the mine is first of all delivered to two No. 7 ball mills, manufactured by Johnson, of Leeds, and is crushed to 30 mesh. Thence it is discharged to bins and conveyed as required to circular dissolving tanks, of which there are six, the dimensions being 23 ft. 9 in. diameter and 8 ft. depth. There the caustic-soda solution is pumped upon the sands and drawn through them in much the same way that solutions of cyanide are applied upon the Rand. The resultant solution, carrying the antimony sulphide chemically combined, is drained off to three carbonators, where it is treated with carbonic-acid gases from a limekiln. The antimony is precipitated as an amorphous sulphide, and the sludge is pumped to the ordinary type of filter press and pressed into cakes, which are finally dried and made ready for the market. The solution from the filter press goes back to stock tanks for use over again. The sand residue is treated in the usual way by cyanide solution.

Another Tube-Mill Lining

By Algernon Del Mar*

Silex linings for tube mills are being displaced by metal linings of the Komata or El Oro types, not only by reason of the better results from them, but because the time required to reline a tube mill with silex makes it the most costly of all, particularly in small installations where only one mill is in use. The idea of cementing pebbles in the



FRAMES AND PEBBLES FOR TUBE-MILL LINING

mill to form a lining is as old as the use of pebbles. Many have tried it with success and many with failure, but the time element required for the cement to set must be included as an objectionable factor. Cement blocks with the pebbles in the matrix, made the size to fit in like bricks, have been tried and failed, and then cementing pebbles or mine rock into a modification of El Oro lining has been tried with some success. The idea illustrated may or may not have been tried, but it appears at all events to be worthy of trial and record.

Cast-iron frames are made, open at the bottom, so that 8 sections will just go inside the circumference of the mill. Into these forms pebbles are cemented months before the time required for their use, so that they will have thoroughly set and hardened. When the mill is ready to reline, these forms are put in, brick fashion, in a cement-and-sand mortar and keyed with wedges so that the mill may be started within a day after the lining has been put in place. The forms are made in two sizes

*Mining engineer, Nelson, Nev.

for overlapping. The cast-iron skeleton forms are, of course, left in to wear with the cemented pebbles. The short time for taking out a worn lining and replacing it with a new one would be the best recommendation for this kind of lining.

The sides of the castings may be 1 in. thick, the ends ½ in., the depth 4 in. and the length 1 or 2 ft., with variations depending on the size of the tube mill in use.

Treatment of Wounds*

Every wound, whether large or small, has for its possessor an interest. In every wound—that is, in every injury where the skin or mucous membrane of the body has been broken—there lies the possibility of an inflammation that may become serious. On this account no injury of this sort, whether it be a simple abraded skin, a clean cut or a jagged, extensive opening into the tissues, should be neglected.

The treatment of open wounds is simple, but must be done with understanding. Nature is the chiefest physician whose aid is never failing if due heed is paid to her law. When a wound is made, there is an immediate oozing, or bleeding, from its surface, and in this blood, or serum, there is nature's first application of an antiseptic. The living blood has a certain resistance to inflammation-producing germs, but the dying blood, such as that which escapes from a wound and clots upon its surface, is many times more destructive of germ life than the living; therefore, this blood that is being exuded upon the surface of the wound is the first great antiseptic application, washing away infection directly from within outward and helping to destroy the germs that may have been implanted by the injury.

To this should be added the surgeon's aid. It was a practice in olden times, and even up until recent date, immediately to wash these wounds with a solution containing carbolic acid, corrosive sublimate, lysol, iodine or some antiseptic agent. The idea was that in washing the wound it was cleansed, and in the application of a dilute antiseptic the germs present were killed. From much experience and tedious experiment the medical profession has definitely proved that, instead of cleansing the wound, washing more often carries germs into it, and the antiseptics used are so dilute that instead of destroying germs they are practically useless. On this account the wounds which were washed most carefully were often the wounds which inflamed and developed pus shortly afterward. Through this knowledge it became apparent that the best way to handle a wound was simply to protect it.

At times, when wounds are occasioned by instruments probably holding highly poisonous germs or in localities where such poisonous germs are apt to be found, it is necessary to use some measure to destroy such as might have been carried into the wound. To accomplish this purpose two agents are best used—one a concentrated tincture of iodine, and the other pure carbolic acid. In a wound where infection is suspected, it is a good plan to drop into it some tincture of iodine. If, however, there is good reason to believe that the wound is seriously infected, the surgeon usually makes an application of pure carbolic acid to its entire surface, then wipes it dry of all excess. This, when done immediately or shortly after receiving the injury, will practically always prevent germs from growing in the wound.

One other disturbing thing in the healing of the wounds is the presence of some foreign matter like rock or splinters or small fragments of metal. As a rule these particles do not carry serious infection in with them, but in all cases they should be removed if this can be accomplished without too much further injury to the already wounded tissue. They can never be washed out well; therefore, here again water or antiseptic solutions are out of place. Small forceps or dry bits of gauze are used to remove these foreign bodies, the removal being purely by mechanical means.

The use of peroxide of hydrogen in or upon wounded surfaces has been often advocated. This will be found to be in error. It diminishes the antiseptic action of the blood on the wounded surface and does not offer a better antiseptic or even one nearly so good in its place.

Particularly must it be remembered that wounds through skin that is blackened by coal dust or dirt from working about engines are certain to be made worse by any effort to cleanse the skin about the wound. Such a wound should be most carefully dressed dry, without washing, plus usually the application of iodine or the mild cauterizing of its surface with carbolic acid.

To summarize then, simple wounds dressed dry and unwashed, or touched with carbolic acid or iodine, heal better than when they are washed with any solution whatever. The more extensive wounds must be handled in the same way, cleansed of foreign bodies mechanically and dressed dry. If these wounds are washed they always suppurate or have matter formed in them. This knowledge of the conduct of wounds has led to the present-day simple "first-aid package" that every soldier carries with him into battle. Regardless of the nature of a wound he receives, it is dressed with a dry piece of gauze and usually left untouched for several days. The results have become much better in warfare through this means, and the soldiers are returned to the battle line again in much shorter time.

*An article by Dr. T. C. Witherspoon in "The Anode," December, 1915.

Pan Grinding in Australia

At the mill of the Sons of Gwalia, in Western Australia, two kinds of machines—tube mills and pans—are in use for regrinding, according to *Monthly Journal* of the Chamber of Mines, Sept. 30, 1915. The pans are in use because they were installed before tube mills came into use and also because they provide for efficient amalgamation even when grinding in cyanide solution. The recovery of gold as amalgam in the pans amounts to 20% of the output, and if the extraction of it were left to the cyanide process, the whole of the solution throughout the plant would be increased in value and the loss in the residue would rise probably 0.2s. per ton.

Had the pans not been installed first, an alternative arrangement would have been the use of amalgamating plates after tube milling. Tests show that the tube-mill grinding makes a further 25% of the gold available for extraction by amalgamation, but whether this amount could be more profitably extracted as amalgam than by the cyanide process is a question that only a trial could decide. It appears that none of it is discharged in tailings, since amalgamation tests on the latter show no recovery.

The Cost of Doing Things

Costs of Churn Drilling at Sacramento Hill*

During a considerable development campaign by the Copper Queen Consolidated at Bisbee, Ariz., a Star drill, operating on ground similar to Sacramento Hill, had drilled 8,000 ft. of holes at an expense, exclusive of the cost of the drill, of $2.70 per ft., made up of labor and supplies, $1.99, and rods, $0.71.

TABLE 1. NO. 1 CHURN DRILLS (OPERATED BY STEAM)

	Cost	Cost per Foot	Per Cent. of Cost
Labor—			
Drilling	$13,497.62	$0.469	33.5
Casing	2,113.50	.073	5.2
Fishing	564.86	.020	1.4
Moving	5,679.03	.197	14.1
Repairing	3,488.94	.121	...
	$25,343.95	$0.881	62.8
Supplies—			
Coal	$3,819.22	$0.133	8.7
Casing	1,336.16	.046	3.3
Drilling tools	2,880.33	.100	7.1
Cordage	2,334.01	.081	5.8
Miscellaneous	1,779.90	.062	4.4
	$12,149.62	$0.422	30.1
Storehouse	$126.11	....	...
Water line	413.57	....	...
Air line	16.95	....	...
Steam line	275.20	....	...
	$831.83	$0.029	2.1
Teaming	$2,000.00	....	5.0
Total	$40,325.40	$1.402	100.0
Footage drilled, 28,770½.			
Footage drilled per 8-hr. shift, 16.7.	3,734.87		
Initial costs	$44,060.27		

TABLE 2. NOS. 2 AND 3 CHURN DRILLS (OPERATED BY ELECTRICITY)

	Cost	Cost per Foot	Per Cent. of Cost
Labor—			
Drilling	$3,867.45	$0.466	32.7
Casing	1,215.25	.146	10.3
Fishing	597.24	.072	5.0
Moving	1,696.82	.204	14.3
Repairing	698.06	.084	5.9
	$8,074.82	$09.73	68.2
Supplies—			
Casing	$170.39	$0.021	1.4
Drilling tools	548.56	.066	4.6
Cordage	770.40	.093	6.5
Miscellaneous	1,610.81	.194	13.6
	$3,100.16	$0.373	26.2
Electric power	$276.22	$0.033	2.3
Teaming	370.65	.045	3.1
Total	$11,821.85	$1.425	100.0
Footage drilled, 8,294.			
Footage drilled per 8-hr. shift, 15.2.			
Initial costs	$6,578.75		
Electric power line—			
Labor	$486.69		
Supplies	1,434.77		
	$1,921.46		
Grand total drills Nos. 2 and 3	$20,322.06		
Grand total drill No. 1	44,060.27		
Assaying cost	1,132.59		
Roads—			
Labor	$21,055.55		
Supplies	1,010.22		
	$22,065.77		
Grand total	$88,412.41	$2.385	
Total footage, 37,064½.			
Average depth of hole, 427 ft.			
Footage of roads, 21,814.			
Cost per foot of roads	$1.01		

*Excerpt from paper presented at San Francisco meeting of A. I. M. E., September, 1915, by Arthur Notman, chief geologist, Copper Queen Consolidated Mining Co., Bisbee, Ariz.

It was decided to drill Sacramento Hill. The work was laid out on 100-ft. squares, with the ore developed underground as starting points. Roads were laid out on the ground to cover the orebodies and their probable extensions with 100-ft. squares, with the minimum amount of road building.

Tables 1 and 2 give the costs obtained in this work. The figures for No. 1, or the steam drill, cover a period of 22 months, during which time 12,153 ft. was drilled in outside ground and 16,617.5 ft. in Sacramento Hill. The figures for the Nos. 2 and 3 electric drills cover a period of only 3½ months.

The following table gives the cost for the steam drill on Sacramento Hill alone:

TABLE 3. NO. 1 CHURN DRILL (SACRAMENTO HILL)

	Cost	Cost per Foot	Per Cent. of Cost
Labor—			
Drilling	$7,696.85	$0.463	41.5
Casing	1,261.84	.076	6.8
Fishing	253.51	.015	1.3
Moving	2,939.66	.178	16.0
Repairing	1,732.93	.104	9.3
	$13,904.79	$0.836	74.9
Supplies—			
Coal	$1,702.63	$0.102	9.1
Miscellaneous	1,867.51	.112	10.1
Water lines	237.39	.014	1.3
Teaming	850.00	.051	4.6
Total	$18,562.32	$1.115	100.0
Footage drilled, 16,617½.			
Footage drilled per 8-hr. shift, 20.4.			
Teaming estimated.			

The larger part of the work by No. 1 was done in nearly barren ground of uniform character, while that of the electric drills was done entirely in ore-bearing ground, where the changes from strongly silicified leached capping to soft enriched ore and harder primary material rendered the drilling much more difficult. For a three months' period, in which the drills were working under essentially similar conditions, the following figures were obtained:

OPERATING EXPENSE

	No. 1 Steam	No. 2 Electric	No. 3 Electric
Cost per foot	$1.34	$1.56	$1.15
Footage drilled	4,169	3,198	4,510

No. 2 drill was operating in exceptionally bad ground, and while not conclusive, these figures indicate that eventually the electric drills should be operated at from 10 to 25c. per foot cheaper than the steam drill, under the conditions obtaining.

In considering the cost of power on the two types the widest differences in the cost of operation are encountered. The cost of teaming on the steam drill, at least 60% of which is chargeable to the coal, is not very accurate, but would indicate a cost of 17½c. per ft. for the coal and another 2½c. for pipe lines, or a total of 20c. per ft.

Electric power cost only 3.3c. There is no teaming to be charged against it, while the proper charge for the installation of the power line depends on the amount of drilling to be done. For a minimum of 30,000 ft. this would amount to 6.4c. per ft., or a total of 9.7c. per ft., or less than one-half the power cost of the steam drill.

The 4c. difference in the item of drilling tools in favor of the electric drill is more apparent than real, inasmuch as the steam machine was put into commission more than

a year prior to the starting of the electric drills and some of the tools then purchased have been used on all machines.

The 13c. difference in miscellaneous supplies in favor of the steam drill, on the other hand, is due to the fact that a considerable portion of this item might very reasonably have been charged to initial costs.

The initial costs include the purchase price of the machines, the freight and, with the exception just noted, all additional permanent equipment.

The road building completed is sufficient for a total of 60,000 ft. of drilling to an average depth of 400 ft., or a cost of 36.8c. per ft. of hole drilled.

The assaying cost amounts to 3.5c. per ft.

The roads built are 9 ft. wide, excepting at turns, where they are 12 ft. wide. There was a great deal of rockwork and dry walling to be done. In general, the roads follow the contours of the hill.

The initial costs of the three machines, distributed over a minimum of 60,000 ft., amount to 17.2c. per ft.

These figures would indicate the following complete costs for 60,000 ft. of drilling: Initial costs, $0.17 per ft.; operating expense, 1.43; road building, 0.37; total, $1.97.

A salvage of 7c. a foot on the initial costs might be reasonably allowed, and it seems probable that the operating expense can be lowered another 5c. to 10c. per ft., giving an average cost of about $1.80 per ft. for a minimum of 60,000 ft. of drilling.

Conclusions waranted by results obtained are: (1) That 60 to 75% of the operating cost is labor. (2) That the labor item is materially affected by the supply of tools and the accessibility to a machine shop for heavy repairs. (3) That the choice of power in churn drilling cannot affect the costs obtained, excepting to a very minor extent. In the present case, the low cost of electrical power, due to the proximity to the central power house, determined the selection.

A 75,000-Ton Blast

A 75,000-ton blast was made at a West Virginia quarry recently at a total cost of 3.3c. per ton, according to the *Du Pont Magazine*. There were fifteen 6-in. holes. All but two of these holes were about 125 ft. deep and extended about 5 ft. below the quarry floor. The two short holes were 72 ft. and 85 ft. deep respectively. All holes averaged about 15 ft. apart with a burden at the top of 8 to 12 ft. and a burden at the bottom of 25 to 35 ft.

In each hole there was loaded from 400 to 500 lb. of Du Pont gelatin, 60% strength, and on top of this was loaded from 150 to 600 lb. of Du Pont quarry powder. In each hole was placed a line of countered Cordeau to detonate the charge of explosive. This Cordeau was held taut while the cartridges, which had been slit once lengthwise, were dropped down the holes. In ten of the holes the charges were split near the center with from 10 to 20 ft. of clay stemming between the two charges. On top of the top charge there was placed about 20 ft. of clay stemming. In the five holes that were loaded solid there was about 30 ft. of clay stemming on top of the charge.

To each line of Cordeau was attached one No. 6 Du Pont electric blasting cap with 14-ft. wires, by means of a special union made for that purpose. These electric blasting caps were then connected in series, tested, and connected to a No. 4 Pull-Up blasting machine.

About 50% of the stone was broken to one-man size and none was thrown over 100 yd. from the face. The following is a summary of the yardage, amount of explosives used, etc.: Average burden on the holes, 2,000 solid cu.yd.; total burden on the holes, 30,000 solid cu. yd.; average charge of explosives per hole, 900 lb.; total charge of explosives used, about 13,500 lb.; total amount of rock broken, 60,500 loose yd., or 75,000 tons; average, 5.5 tons per lb. of explosive; cost of explosives and blasting supplies, $1,640; cost per ton, 2.2c.; cost of explosives, blasting supplies, drilling and loading, $2,460; total cost per ton, 3.3c.

Some Unit Costs for a Bingham Canon Mine

The following figures are given as pertaining to New Utah Bingham operations in Bingham Cañon, Utah:

Electricity is furnished by the Utah Power and Light Co. on a sliding scale which makes the cost about $200 per month for 65 hp.

Coal is used for fuel and costs $10 per ton delivered.

Lumber and mining timber cost $30 per M delivered. Freight from station to mine is $4 per ton, and ore is hauled to railroad station for $1.25 per ton.

Laborers are paid: Foremen, $5; shift boss, $3.75; machine men, $3.50; helpers, $3.25; muckers, etc., $3.25; blacksmiths, $4; teamsters, $3 per day of 8 hr.

Contract work costs as follows: Shaft sinking, 4x8 ft., $18 per ft.; drifts on vein, 4x7 ft., $4 to $6 per ft.; crosscut tunnels, 4x7 ft., $6 to $10 per ft.; raises, 4x6 ft., $4 to $6 per ft.; winzes, 4x6 ft., $5 to $8 per ft.

Cost of Plant per Kilowatt

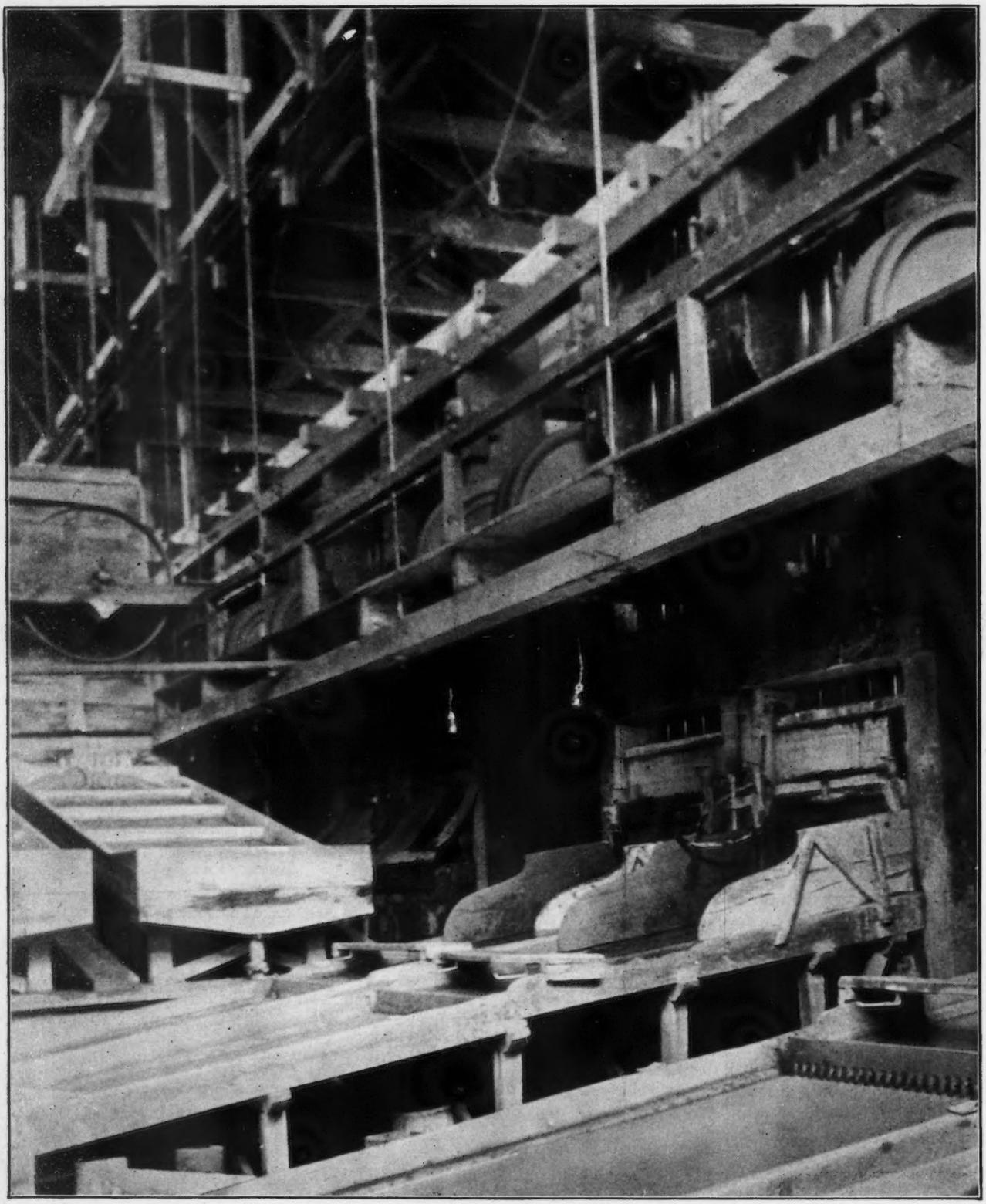
An abridged statement of costs of a 2,900-kw. steam plant owned and operated by the Bay State Railway Co., at East Woburn, Mass., showing, as nearly as it was possible to procure them, the amounts of money expended on the installation from its original construction about a dozen years ago down to last year, is given in *Power*, Jan. 4, 1916. These figures do not mean that these detailed costs would apply in building another station, but they at least furnish a basis for comparison and form a starting point for similar analyses by engineers to whom cost data are accessible. Certain allowances for fixed charges were included to arrive at the true plant investment value. The results of the inventory showing costs of property in detail are filed in 10 volumes in the office of the Massachusetts Public Service Commission.

A summary of the plant costs is as follows: Land, $4,536; building and structures, $45,065; chimney, $6,903; coal trestle, shed, etc., $7,499; equipment, $313,139; grand total, $377,142. This is equivalent to a cost of $130.05 per kilowatt.

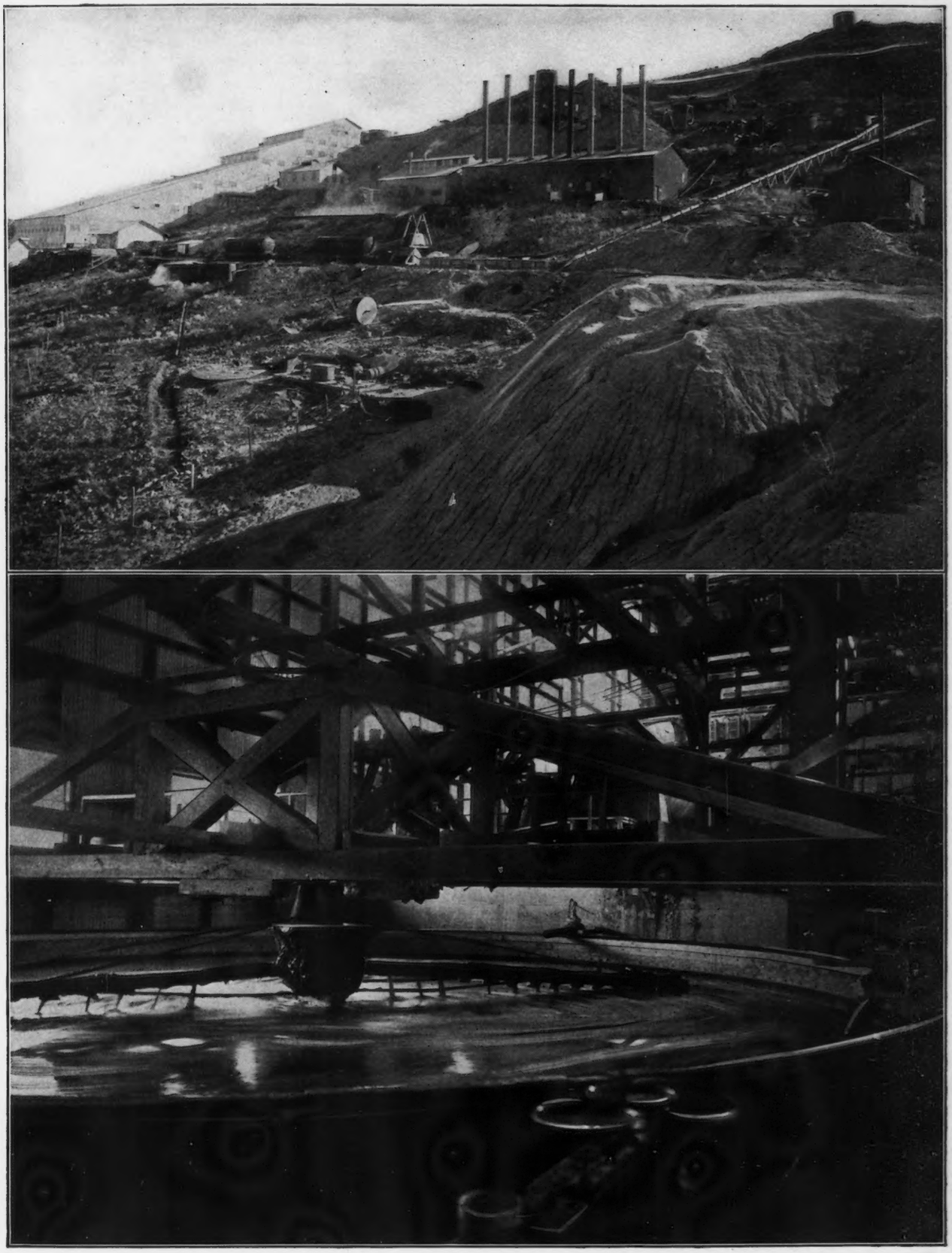
Stoping Costs at Iron Mines, Mineville, N. Y.

In the *Journal* of Nov. 20, 1915, was an article on stoping costs at Mineville, N. Y. The method of mining, which was not mentioned in the interesting article, was underhand stoping.

Photographs from the Field



INTERIOR OF THE TOMBOY MILL, NEAR TELLURIDE, COLO., SHOWING THE STAMPS AND AMALGAMATING TABLES



EXTERIOR AND INTERIOR VIEWS OF THE COMMONWEALTH MILL, AT PEARCE, ARIZ.

This new plant includes the most modern development of cyanide-treatment machinery. It treats a gold ore of good value. It replaces a more primitive plant owned and operated by the same company for several years. The new installation was designed after careful experiments looking to the selection of the best metallurgical methods to secure high extraction and low costs. The plant has been in operation for more than two years

Correspondence and Discussion

Metal Miners' Examination

In the *Journal* of Jan. 1, page 13, is a list of questions which it is stated were given the applicants for positions as foremen of metal mines in an examination conducted by the chief mine inspector of Tennessee.

This list is an excellent and amusing instance of the ridiculous situations that are so often created by ignorant or misguided or overzealous legislators in attempts to regulate or correct practices with which they are unfamiliar. They appear often to approach these problems in the fearsome state of mind depicted by a writer in a recent number of the *Saturday Evening Post,* who used all the lurid colors in his paint-pot in describing the dangers and terrors of copper mining and the "fear" that all miners are supposed to feel for the rope and cage that take them to their work.

Reverting to our examination questions, none of us who is interested in the promotion of safety in mining—and practically every engineer connected with mining can now be included—will be much disposed to complain of the interference of the state in this direction, even when its efforts are clumsy or misdirected, and so I will pass over those questions which have as their evident purpose the determination of the views and experience of the applicant in the prevention of injuries, even though they might justly be criticized as being filled with repetitions. Why, unless from the point of view of "conservation of natural resources" carried to an *n*th power of absurdity, questions like Nos. 14, 18, 20, 40, 44, 45, 46, 47, and 53 and the general portions of Nos. 48, 49 and 54, which deal not with safety but with the general economics of mining that are bound to vary with every district or even every mine, should be asked by a state examiner, is beyond me.

The *Journal's* comment on these questions is certainly mild, and indeed an examiner would have to be clothed with much discretion to interpret the replies, more especially as they are supposed to be written and not oral. It appears to me, however, that were the examiner really possessed of so much discretion the questions would never have been asked. Take No. 53, for example. As a brilliant specimen of vagueness it vies with the classic, "Why is a pickle?"

As it may be supposed that my unkind comments are due to the fact that I took this examination and flunked, I hasten to add that such is not the case, and that in all due humility I admit that anyone who could answer all those questions from his own experience and right off the bat would not only be qualified for mine foreman, but for superintendent or manager; that is, supposing he had the other qualifications, which no written examination can determine. Right here, however, is the point that keeps our jobs for those of us who are running mines, but who, from the standpoint of these questions, ought not even to be foremen.

Imagine any corporation picking out a mine foreman by such a process, and think of all the good mine foremen you know—generally men much better with their hands and brains and profanity than with a pen—who, if they ever got out of a job, would never be able to break in again if an examination like that stood in the way.

The *Journal's* comments touched but lightly on the real thing we want to know about a foreman, and that is, "Can he handle men?" A good foreman is like the type of old sergeant in the regular army. He isn't supposed to know all about the theory and practice of the art of war, and it isn't desirable that he should, because if he did he would either be too big or too little for his job of sergeant, instead of the exact fit that he ought to be. He is, however, supposed to know how to keep his men fit, how to train them for their work, to keep them equally to their tasks, with no shirkers and no slackers, to protect them against themselves as well as the enemy; and if he has the inherent qualifications, he develops in his men that trust and confidence and assurance that are necessary to the accomplishment of any task, military or industrial, and, as Kipling says, can "lift 'em, lift 'em, lift 'em, through the charge that wins the day."

W. O. BORCHERDT.

Austinville, Va., Jan. 8, 1916.

Oxyacetylene Welding at Braden

In the *Journal* of Dec. 4 appeared an article on "Oxyacetylene Welding at Braden," which interested me greatly, as it was I, then master mechanic at Braden, who introduced the process there, not without some opposition and dire prediction of various wiseacres who foretold a speedy relegation to the scrap heap for the entire apparatus.

The manner in which this apparatus was sent to Chile afforded a striking example of that happy-go-lucky method in which some American manufacturers still indulge, thereby not only bringing discredit upon themselves, but on everything American as well. The machine was simply inclosed by ¾x6-in. boards, spaced about 4 in. apart, loosely nailed together, without bands or stays of any kind—at least I judged from the remnants of the crate that it might have been so inclosed. To crown the whole thing the shippers had thoughtfully fastened the necessary instruction cards to this crate, as I found out six months later.

From the very beginning the oxyacetylene torch became popular around the plant. Welding was done, but not extensively, on account of the great amount of cutting that the torch was called upon to do.

The oxyacetylene torch when rightly handled is invaluable around mines, mills and smelters. It will do work that cannot be done any other way, and do it quickly and cheaply. After once installed, the problem is not so much how to find work for it but how to keep the work away from it, as it soon becomes known around the plant as a sort of cure-all and is treated accordingly.

Miami, Ariz., Dec. 15, 1915. P. F. KRUGER.

Flotation at Broken Hill, N. S. W.

Among the extremely important advances being made in flotation at the present time, one of the most vital to the success of the process in general is the development of selective methods by means of which one mineral, or a class of minerals, may be floated to the exclusion of others. The successful development of methods of this kind will be of vital interest in the metallurgy of complex ores such as those in which zinc, lead, iron and other metals occur in sulphide combinations. By adopting the proper means it seems to be possible to float, first, a mineral consisting principally of the compounds of one of these metals, although to some extent mixed with small quantities of the others, and by succeeding steps floating each of the other metal compounds separately. This is accomplished in various ways, depending principally upon the acidity or alkalinity of the pulp, the kind and amount of oil added or the kind of agitation used. In many cases a combination of all three of these essentials may be varied from one step to another.

Of interest in this connection is the new zinc plant installed by the Sulphide Corporation at its Central mine, Broken Hill, N. S. W. This plant, as described in the *Mining and Engineering Review,* Dec. 6, 1915, is now at work. The principal feature of the installation, which has a capacity of about 4,000 tons per week, is the adoption of the Hebbard-Harvey underdrive machine in place of the original Minerals Separation apparatus.

The Hebbard-Harvey Flotation Machine

The Hebbard machine, one of the later developments by Minerals Separation, is in principle similar to the Hoover, usually known as the Minerals Separation machine. The vital difference between the Hebbard and the Hoover types is that in the former dependence is not placed altogether upon the beating of atmospheric air into the mixture while agitation is taking place. On the contrary, a pipe containing air under small pressure is led to a point just beneath the agitating or beating mechanism in the pulp, and a stream of air is delivered at that point. Naturally, a far larger quantity of air can be beaten into the pulp in this way than if dependence were placed merely upon the vortex action of the paddle as it draws air from the surrounding atmosphere. The Hebbard machine, like the Hoover, was originally intended to be driven from the top, but the Harvey improvement is one by means of which the drive is arranged from the bottom, beneath the flotation apparatus. This is believed to be a considerable convenience in many cases.

The plant of the Sulphide Corporation treats the tailings of the lead mill, and the aim is to extract as large a percentage of the lead still contained in the tailings after table concentration, as is possible. The pulp is brought by elevator from the mill to the zinc-plant boxes, into which a small quantity of eucalyptus or other suitable oil is introduced. The exact amount of oil used is not stated, but modern practice has been reducing the quantity required to a very small point, and operators will understand that no great quantity is probably required in this case. In fact, owing to the succeeding treatments, as will be seen, the amount of oil used is probably exceptionally small.

The boxes, or frothing machines, are fitted with special stirrers to agitate and aërate the pulp, creating a froth containing only lead concentrates. Having removed all the lead possible by this means, the pulp passes to other boxes, or frothing apparatus, where sulphuric acid and oil are added. Agitation and aëration take place as before, and the blende is recovered. There are altogether ten boxes—three for lead and seven for zinc.

Improved Results Over Former Practice

The feed to the flotation apparatus averages about 4.2% lead and 18% zinc, while the lead concentrates assay about 50% lead. The residues from the first three boxes assay about 3% lead and 18.5% zinc. The zinc concentrates assay about 6% lead and 47.5% zinc. The tailings, or residues, assay about 1% lead and 2% zinc.

The mill superintendent, R. J. Harvey, in explaining the operations of the plant, pointed out that not only is the process worked in the cold—that is, the use of steam which was formerly employed for raising the temperature of the solution has been omitted altogether—but it is possible to extract an additional 15% of lead and silver, as compared with the process as previously in use. Before, there was about 10% more lead mixed with the zinc than is the case now, the present system producing much better zinc concentrates.

Another feature of great importance is that table concentration on the finer portion of the ore will probably be dispensed with. This introduces a large economy in the maintenance expense of tables and the power required for operating them, to say nothing of the fact, well known among concentrating operators, that only a small percentage of the mineral is recoverable from slimes and extremely fine sand by table concentration. In these ores rhodonite forms a material part of the gangue constitution and is one of the chief difficulties obstructing successful table concentration, since its specific gravity is about halfway between that of blende and galena. Flotation, however, succeeds in getting rid of all of the gangue, including rhodonite, and there is therefore a clear-cut problem of separating the two sulphides in the subsequent tabling operations. Selective flotation promises to solve this problem absolutely and seems to have been exceptionally successful in this particular case.

In this connection it may not be out of place to mention that in some cases it is not by any means impossible to float a certain part of a finely ground ore without oil or acid and with very little agitation. Of course the Macquisten process makes use of this principle in floating sulphides through a special form of tube, but any operator familiar with finely ground ores in wet pulp will easily remember that a certain portion of fine sulphides may be distinguished upon the moving pulp currents in the neighborhood of his concentration plant. Some systems are now being proposed to take advantage of the properties of these particular minerals to float with but little urging, and it seems probable that some successful metallurgical processes will result from them. The varying contents or consistency of the pulp medium, or electrolyte, as it may be called, has a great deal to do with these propensities toward floating, and any system attempting to produce a selective result in this way will probably be based largely upon the composition of the electrolyte. Great developments are expected, and there is little doubt that flotation will make enormous strides in the near future, particularly if it shall be fortunate enough to have its veil of litigious mystery promptly removed.

John A. Bell

John Alexander Hill

John A. Hill, President of the Hill Publishing Co., died suddenly from heart failure on Monday morning, Jan. 24, while traveling in his motor car from his residence in East Orange, N. J., to his office. Mr. Hill had been engaged as usual in business affairs and was to all outward appearances in perfect health. Very few, even of his intimate associates, knew of the organic trouble that resulted in his sudden death.

Mr. Hill was born, Feb. 22, 1858, on a remote hill farm in the town of Sandgate, near Bennington, Vt. While a young lad his parents emigrated to central Wisconsin and he was brought up there in the way to be expected for the son of a pioneer in such a region at such a time. He did chores, herded sheep and attended school a few months during the winter. At 14 years of age he went to work in a country printing office. He had a Yankee boy's liking for mechanics, however, and after some years in the printing office he became half-owner of a machine shop, where he carried on repairs to a variety of local machinery. In 1878, attracted by the new-born excitement in Colorado, he moved thither and promptly went to work as fireman on a Denver & Rio Grande locomotive. Within a year he was promoted to be a locomotive engineer. In later years, when exchanging stories with his mining friends, he always enjoyed telling his experiences in driving his engine over the new line into Leadville, switching ore cars into the smelters' yards, etc. This was in the early days of the D. & R. G. railway, when to drive an engine up the mountains and around the edges of the cañons required nerve and courage, but the young engineer soon gained a reputation for more than ordinary ability and coolheadedness. He also showed that he had higher ambitions than railroading. When he was put in charge of the engine of a snow-plow, its irregular runs gave him more time for study and he applied himself to learning all he could about his work and general mechanics, devoting most of his time to the investigation of technical subjects. After a while he was made a roundhouse foreman and later assistant superintendent of motive power.

We do not know just what led him to leave the railroad and enter journalism, but probably he had a natural bent toward that profession. Anyway, he was inspired to found in 1885 the *Daily Press,* of Pueblo, Colo., which journal he edited for some time. As a writer he had a forceful and breezy style, and his thorough familiarity with practical matters and with the ideas and needs of the men in the shops and on the road enabled him to write articles which were well received by the technical journals of that day.

A number of these articles were contributed to a modest paper called *Locomotive Engineering,* which was published in New York by a company which also published the *American Machinist.* In 1888 Mr. Hill was invited to come to New York and take charge of *Locomotive Engineering.* Under his charge the journal rapidly increased in importance. Seeing the possibilities in the enterprise, Mr. Hill associated himself with Angus Sinclair, purchased the journal from its owners and undertook to carry it on as a separate publication. In this venture Mr. Hill was both editor and publisher, and his genius was well proved by the phenomenal success of the publication. Its subscription list grew by leaps and bounds, and it rapidly assumed the leading position in its field.

The success of *Locomotive Engineering* was largely due to Mr. Hill's ability to give human and general interest to articles on mechanical and engineering subjects. Under the pen name of John Alexander, he contributed a noteworthy series of stories called "Jim Skeever's Object Lessons," and "Stories of the Railroad" that attracted wide attention. His experience as an engineer had taught him the weakness and evils of the old rule of promoting railroad employees according to their length of service, and he advocated a system under which specific subjects were studied by candidates each year and promotions were made according to efficiency—a system which, as embodied in his work on "Progressive Examinations for Locomotive Engineers," was adopted by the Master Mechanics' Association as the standard form of examinations on American railroads. More than 70,000 copies of that little book have been sold.

It was evident to Mr. Hill's keen business sense, however, that a journal appealing chiefly to locomotive runners had not the elements for the largest financial success, and he perceived the opportunity of applying modern business and editorial methods to the *American Machinist,* a journal of high standing and reputation, which had been conducted for years along ultra-conservative lines. In 1896 Mr. Hill sold his interest in *Locomotive Engineering* to his partner, Mr. Sinclair, purchased the *American Machinist* and laid the foundation for one of the largest enterprises in the field of technical publication ever established.

At that time practically all class publications had their printing done by contract and were limited by such facilities as the printers were willing to provide. Mr. Hill's early experience in the printing business had given him a strong liking for this side of the publisher's work, and he was ambitious that his publication should be able to own and operate its own printing plant. In order that such a printing plant shall be commercially successful, however, it cannot concentrate its work upon a single journal, but must be able to distribute it over a number.

It was this situation among others that led Mr. Hill to add to the successful *American Machinist* other well-established technical journals of high reputation. His first purchase was *Power.* Then, in 1904, the *Engineering and Mining Journal* passed into his hands. In 1912 he purchased the *Engineering News* from its founder and chief owner, George H. Frost.

Coal Age had been established in 1911 to cover a field which it had become evident was too broad to be successfully reached by the *Engineering and Mining Journal,* chiefly devoted to metal-mining interests.

To carry on these various publications, Mr. Hill organized the Hill Publishing Co., in which, while he held the largest interest, a number of those associated in the conduct of the several journals were also stockholders. Besides these enterprises in the field of American technical journalism, Mr. Hill established branch houses in London and Berlin, where foreign editions of the *American*

Machinist were issued. The publication weekly in Germany of a translation of the American edition of the *American Machinist* under the name of *Maschinenbau* was a feat of which Mr. Hill was justly proud. No other publisher of an engineering paper ever ventured upon such a bold step and made a success of it.

When the *Engineering and Mining Journal* was acquired by the Hill Publishing Co. it possessed a book-publishing department which for many years had been conducted in a rather ineffective way. Mr. Hill promptly discerned the weakness of this and its possibilities and set about a proper development of this business, which within a few years achieved great success. Later it was consolidated with the similar business of the McGraw Publishing Co. and was taken over by the McGraw-Hill Book Co., Inc., of which Mr. Hill became president. This company is now the largest publisher of engineering and scientific books in the world.

An enterprise in which Mr. Hill took great pride and to which he devoted some of the best energy of the last years of his life was the construction on the west side of New York City of the great building to house his publications, which was completed in 1914. It was characteristic of Mr. Hill that the building was not only planned at every point to suit the convenience and economy of the printing and publishing business, but that unusual provision was made for the safety, comfort and health of the army of workers in the building. In this building and equipment were embodied the things that Mr. Hill had dreamed of during many years as the ideal in printing-house construction.

Mr. Hill's idea in conducting a group of engineering papers was to effect economy in manufacturing cost and in many expenses—administration, accounting, maintenance of circulation, etc.—that are inherently common to all and may therefore be shared advantageously. Editorially each publication was ever maintained as an institution, independent of the others and of any influence outside of the editorial rooms. It was a proud saying of Mr. Hill that he never interfered with his editors; that they alone were responsible for their papers and said what they pleased, without hindrance. This was the truth. On the other hand, there was never a leader so loyal, courageous and generous in supporting his editors as was John Hill. He was a man who would fight for a principle, and many a time did so. He masqueraded as a matter-of-fact materialist to try to keep the world from knowing him for the idealist that he really was. Modesty was one of his most noteworthy characteristics. Every now and then he would unconsciously surprise his friends by an exhibition of a breadth of reading and study and a knowledge of subjects that no one suspected.

In his career as a publisher Mr. Hill introduced many reforms—the standardization of the size of technical journals, the principle of truthful statement of circulation, the nonreturn from newsdealers, the nonpayment of commissions to advertising agents—and he kept his advertising on the high plane of means for selling honest goods, and that only. Another thing that he had greatly at heart was the typographical excellence of his papers, the superiority of their engravings and high quality in everything. Merchants and manufacturers, the advertising and the reading public all owe more to Mr. Hill than they appreciate.

Mr. Hill was married in Wisconsin in 1882 to Emma B. Carlisle, who with one daughter survives him, as do also his father and a brother. Mr. Hill was by nature modest and retiring. He was a genial man, fond of companionship and with an endless fund of good stories, but social life and club life had little attraction for him, and his two chief interests were the enterprise he had created, in which he took such pride, and his home. He was essentially a man of broad human sympathies. He took a fatherly interest in the welfare of his employees and delighted to have them refer to him as "The Old Man."

For many years it had been Mr. Hill's custom to write a Christmas greeting, accompanying a bank-note, that reached every employee on the afternoon before the holiday. The one for last Christmas is so typical of his kindly interest in those around him, as well as showing the individuality of his literary style, that it is quoted below:

"The year 1915 is almost gone; it has brought more loss, suffering, death and despair to the human race than any other year of all recorded time, and yet, it has been good to us.

"We have not done so well as in former years, yet we have done well.

"We are all here—not a funeral or a serious illness in our ranks. Most of us are warm and eat regularly—Allah be praised!

"All signs are favorable for better times, the optimist is in charge and the pessimist has been run over by the steam roller that is making the road to business clear—this concern is full of hope and that 'Christmas feeling.'

"Most people dislike to get a bill at this time of the year, but here's one that you need not pay, so we think it will be welcome.

"With it goes a 'thank you' for every little item of service you have furnished this past year which has gone to make up the million-dollar mosaic that this company has made out of all our little items of service combined.

"If your heart and mind be charged with as much good-will, love and respect for the Hill Publishing Company as the institution has for you, the next year will be comfortable and happy for the whole works—big wheels, little wheels, case and fob."

The esteem in which Mr. Hill was regarded by his employees was put into words engraved on a bronze tablet over an ornamental fountain presented to him soon after the new Hill Building was completed. This is the inscription:

"Within this monument to independence, truth and service in engineering journalism the employees of the Hill Publishing Company have placed this tablet—an appreciation of the man and employer, John A. Hill."

Mr. Hill was vice-president of the Machinery Club, a member of the Engineers' Club of New York and of the Railroad Club, the Campfire Club and of the American Society of Mechanical Engineers, to which he was elected in 1913, among his references being Thomas A. Edison and James Hartness. As a young man he was greatly interested in the National Guard, although not a member. During the last year he was vice-chairman of the Committee of Engineering Reserve Corps of the American Society of Mechanical Engineers, charged with the duty of working out the details of a plan to create a corps of civilian engineers for emergency service for the United States Army.

Editorials

Copper After the War

The end of the war is not yet in sight, but an end there is going to be some day and with it there are going to be trade problems but little less complicated than those which arose at the beginning of the war. Already the copper producers are beginning to think of these. Let it be said right away that the consensus of opinion among them is that immediately after the war there is going to be a great demand for copper, especially from Germany, to replace that which has been abstracted from the needs of housing, transportation, etc. The question that is troubling the copper producers is not how they are going to dispose of their copper, but how they are going to satisfy the European demand.

One of the subjects that will arise relates to contracts that could not be filled after the outbreak of the war; that is, most of the copper producers had previously entered into contracts with German buyers for the delivery of copper in August, September, October, etc., of 1914, which became impossible of fulfillment. We understand that legally the buyers could not enforce such contracts after the war is over, but we believe it to be the general intention of the producers to carry out those contracts as soon as possible, in all cases where the buyer within a reasonable time has expressed his desire for their execution, at the price written upon them in 1914, although it is the common expectation that the prevailing price of copper will be much higher upon termination of the war than it was in 1914. Such a policy would be inspired by their pride in their American name and the traditions of uprightness that there have always been in their business dealings with Europe.

However, there are incidental questions that will have to receive careful consideration before any line of policy can be determined. These relate largely to the matter of ocean freights, which have been so greatly disturbed and probably will continue to be long after the war is over. Another serious question is that of insurance. The waters around Europe will be dangerous from loose, floating mines for many months after hostilities have ceased, and insurance rates will consequently be far above the normal. Who shall pay the extra charges on this account? It seems that this is something that ought to be borne by the buyer.

The matter of freight rates itself is a far more knotty problem. At present the charge for carrying copper to British and French ports is six or seven times higher than it was in July, 1914. After the war it will go down—perhaps it will start downward before the war is over—but it will be probably months before it is down to the normal level. What is the shipper who sold copper at a certain price c.i.f. in July, 1914, and proposes to fulfill the contract in 1916, or 1917, or 1918 going to do about this?

The termination of the war will add to the ocean-carrying capacity a large tonnage of ships immobilized during the war. This should tend to reduce freight rates. But suppose the German government takes a hand in the replenishment of the copper resources of Germany? Suppose copper is bought f.o.b. New York and the German merchant marine is commandeered to carry that particular copper to Germany? What then would be the position of the American producers in filling their old contracts?

These are some of the questions that are going to arise and are already engaging the attention of the copper producers. They are questions that concern not only them, but also the consumers in Europe and the steamship companies. It is not too early to enter upon consideration of the ways whereby the business is to be adjusted.

Wages in the Steel Trade

The action of the Steel Corporation in advancing wages about 10% has been generally followed by independent manufacturers and has put wages in the iron and steel trades on the highest level ever reached. The independents necessarily followed the action of the Corporation, which was really a measure of precaution, perhaps accelerated a little in time by the Youngstown strike. The manufacturers realize that in the present condition of the iron and steel trades stoppages on account of strikes or scarcity of labor are likely to be disastrous, and they seem to have taken prompt steps to avert such trouble. There was some loss, of unskilled labor especially, after the war in Europe began, and a number of foreigners left to join the armies of their respective countries. Their places have not been taken, since immigration in the last year has been very light, and other trades besides iron are now employing their full tale of men—or as near it as they can get.

Experience shows that an advance in wages like this is very hard to recall, and that while there may be some reduction in rates they never go quite down to the preceding level. The present activity in the trade seems likely to last through at least the greater part of this year. Whatever may happen in the twelve months of 1916 the wage standard now set is likely to hold through the year.

Opinions differ widely as to the probable result should peace be reached. Some hold that there will be a rush of immigration that will bring down the prices of unskilled labor through excessive competition; while others hold that there will be no surplus of labor to spare, but that competition will be felt through the offer here of goods made by cheaper labor abroad. Time will show which opinion is correct. The only certain point is that the stress of competition will come—when is still exceedingly uncertain.

One thing must not be forgotten. The coal-mining agreements which cover a large part of the country will expire with March, and new adjustments are to be made. With the example before them of large increase in iron-working and mining wages, the coal miners are not likely to be satisfied unless there is a substantial advance in mining rates. Higher wages are in the air, and the coal men may as well prepare for them.

Resolution on Mexican Outrage by A. I. M. E. Directors

At a meeting of the board of directors of the American Institute of Mining Engineers, held on Jan. 21, 1916, the following resolution was passed:

Resolved, that this Board has learned with indignation and sorrow of the unprovoked and brutal murder of 18 American citizens on Jan. 10, 1916, in the State of Chihuahua, Mexico, and laments especially the death of Messrs. C. R. Watson, C. A. Pringle, H. C. Hase and W. J. Wallace, who were members of the American Institute of Mining Engineers. As these men and their companions were engaged in the lawful prosecution of their work, we trust that nothing will be allowed to prevent or delay appropriate action by our Government concerning the outrage by which they lost their lives.

Resolved, that the sincere sympathy of this Board and of all the members of the Institute is extended to the families and friends of Messrs. C. R. Watson, C. A. Pringle, H. C. Hase and W. J. Wallace.

And Be It Further Resolved, that a copy of this resolution be sent to the Secretary of State of the United States, be published in the Institute's Bulletin, in the press, and be sent to the families of the deceased members.

Andes Copper Incorporations

The Andes Copper Co., the Andes Copper Mining Co. and the Potrerillos Railway Co. were incorporated in Delaware Jan. 20, to take over and operate the Potrerillos mining properties, which have been under development for several years by William Braden and later by the Andes Exploration Co.

The Andes Copper Mining Co., capital $50,000,000, will own and operate the properties. The railway company, capital $5,000,000, will build a road from Pueblo Hundido, on the government railway, to the site of the reduction works and mines, a distance of about 80 mi. The Andes Copper Co., capital $50,000,000, is the holding company of the stock of both the railway and mining corporations.

It is understood that the Anaconda will have the majority of the stock of the holding company, and William Braden and associates, a minority interest. It is not generally known that the Anaconda company became interested in this enterprise over two years ago, the negotiation having been initiated by C. C. Burger and Messmore Kendall, the latter acting for Mr. Braden who was in South America at the time. On Jan. 22, 1916, B. B. Thayer, William Braden, Dr. L. D. Ricketts and a staff of engineers and specialists sailed for Chile to undertake the preliminary work in connection with the further development and exploitation of the Potrerillos properties.

California Derricks Wrecked by Cyclonic Storm

An unusual wind storm on Jan. 17 destroyed 485 oil derricks in the Midway and McKittrick fields in California. Midway field lost 272 rigs and McKittrick 213 rigs. Associated Oil was the heaviest loser, having 64 rigs demolished; Kern Trading & Oil lost 45, General Petroleum, 39; Santa Fe, North American and Chanslor-Canfield, 25 each. Standard Oil was among the more fortunate operators who lost only 1 rig. Hurried estimates of damage placed the figures at less than half the actual damage reported; after more careful investigation it is estimated that $1,250,000. The loss in the Midway field is placed at $750,000 and in McKittrick, $500,000.

A 10,000-bbl. storage tank on a lease of the Midway Consolidated, Ltd., was blown in, and on the property of the Canadian Pacific Oil Co. adjoining, a tank about the same size collapsed. Boiler houses, smoke-stacks and other surface buildings were demolished or blown down. Companies began preparations for reconstruction immediately, and rig builders are demanding $10 per day. Of the towns in the fields, Taft suffered most.

British Columbia Mining, 1915

VICTORIA CORRESPONDENCE

An estimate of the value of the mineral production of British Columbia in 1915 gives a total of between $29,500,000 and $30,000,000. This compares with $26,388,825 for 1914, which year was also affected by war conditions, but to a larger extent unfavorably; with $30,296,398 for 1913; and with $32,440,800 for 1912, which was the record year for value of mineral production in the province. However, as prices of some of the metals fluctuate year by year, the best comparison is that of quantities of minerals produced in the several years respectively, which are shown in the table, the figures for 1915 being estimates:

STATISTICS OF MINERAL PRODUCTS

	1913	1914	1915 (Estimated)
Gold, placer, oz.	25,500	28,250	34,500
Gold, lode, oz.	272,254	247,170	257,500
Silver, oz.	3,465,856	3,602,180	3,700,000
Lead, lb.	55,364,677	50,625,048	45,306,000
Copper, lb.	46,460,305	45,009,699	57,400,000
Zinc, lb.	6,758,768	7,866,467	12,000,000
Coal, tons of 2,240 lb.	2,137,483	1,810,867	1,552,000
Coke, tons of 2,240 lb.	286,045	234,577	248,500
Miscellaneous products	$3,398,100	$2,852,917	$2,000,000

It will be seen that, in comparison with 1914, last year's production shows increases in all but lead, coal and miscellaneous products. In copper the increase was more than 12,000,000 lb., and in zinc more than 4,000,000 lb.

As in other years, the production of placer gold was chiefly in the Atlin division of Cassiar district and in Cariboo district. Of an estimated total of 34,500 oz., which was 6,250 oz. more than that of 1914 and was also the highest yearly total since 1907, Atlin's proportion of Cassiar's total of 18,500 oz. was 17,000 oz.; Cariboo's yield was 13,750 oz., of which only a small portion came from Quesnel division of that district. Fort Steele division of East Kootenay is credited with 500 oz. and the Omineca division, south of Cassiar, with 400 oz. Yields from all other parts of the province were comparatively small.

Lode gold came from the gold-copper mines of Rossland to an estimated amount of about 156,000 oz. out of a total for the whole province of 257,500 oz. Other contributing districts were Boundary and Similkameen districts, the copper-gold mines of the former (chiefly those of the Granby Consolidated Co. in Phœnix camp, which made an output of about 37,000 oz.) having a total of 44,000 oz. and the Hedley Gold Mining Co.'s Nickel Plate mine in the latter district rather more than 38,000 oz. Mines in the Nelson division of West Kootenay, with the Queen, at Sheep Creek, a long way in the lead, yielded nearly 9,000 oz.; the Granby Consolidated Co.'s Hidden Creek mine, near Observatory Inlet, nearly 5,000 oz.; the Marble Bay mine, or Texada Island, about 1,500 oz., and numerous other mines scattered throughout the active mining districts, the remaining 4,000 to 4,500 oz. of the total gold production.

PERSONALS

J. V. N. Dorr has gone to Denver.

Robert E. Cranston, of San Francisco, was in New York last week.

Sydney H. Ball has returned from examining mining property in Newfoundland.

B. Magnus has just returned from a trip to the West and Southwest and will be at his office, 61 Broadway, New York.

Ambrose Monell, of New York, was in Ottawa recently in connection with the proposal of the Canadian government to establish a nickel refinery in Canada.

Thomas Gibson, of Toronto, Ont., formerly president of the Lake Superior Corporation, has enlisted for overseas service and will go as major of the 168th Battalion.

George S. Rice, chief mining engineer of the U. S. Bureau of Mines, announces that his official headquarters are at Washington, D. C., from Jan. 15, and not at Pittsburgh.

Nathan O. Lawton is at Sneedville, Hancock County, Tenn., as manager of explorations of about 10,000 acres of mineral lands. He expects to be there for about five months.

An office for the practice of the law, with special regard to French, Spanish and South American affairs, has been opened at 71 Broadway, New York, by Lindell Theodore Bates.

Leighton Stewart, mining engineer for the Andes Exploration Co., Santiago, Chile, was married on Jan. 15 to Miss Helen M. R. Christie, at Amherst, Nova Scotia, and returned to Chile on Jan. 22.

Arthur W. Burgren has resigned his position with the Cinco Minas Co. and has returned to the Dolores mines of the American Smelting and Refining Co. at Matehuala, San Luis Potosi, Mexico.

Frank Hervey Pettingell, formerly of Colorado Springs and Denver, and for several years president of the Colorado Mining Stock Exchange, has been chosen president of the Los Angeles Stock Exchange.

H. D. Orr, who recently resigned as mine inspector for the first district of West Virginia, will leave at once to take up his new duties as superintendent for the United States Smelting, Refining and Mining Co. at Black Hawk, Utah.

H. A. J. Wilkens and W. B. Devereux, Jr., have formed a co-partnership to carry on the general business of consulting mining engineers and mine managers under the firm name of Wilkens & Devereux. Their New York address is 120 Broadway, and they will have representatives in Mexico City and London.

Phanor J. Eder, 60 Wall St., New York, announces that he has become associated with Dr. Emilo Tagle Rodriguez, a Chilean lawyer, whose principal office is at Huerfanos, 840, Santiago de Chile. Especial attention will be given to the law in matters arising between the United States and the Latin American countries.

OBITUARY

A. H. Osborne, a mining engineer of Georgetown, Colo., and Edward Collins, of Silver Plume, were killed on Jan. 6 by a snowslide near the Josephine mine, in the West Argentine District.

John Fulton died at his home in Johnstown, Penn., Jan. 22, aged 89 years. He was of Scotch-Irish ancestry and was born in Ulster, Ireland, in 1826, being educated in local schools and in Dublin. In 1846 he found his first employment as an assistant engineer in the construction of the Great Western R.R. from Dublin to Galway. In 1848, he came to this country with his father and for a time found employment as a laborer on the railroad then being built from Honesdale to Hawley, Penn. He was quickly promoted to be foreman and later, assistant engineer, in which capacity he was employed on the North Branch Canal, then under construction, and had special charge of the large aqueduct at Tunkhannock. Later he was assistant engineer under Thomas W. Wierman on the Junction Canal, and later on the Barclay R.R. from Towanda to the coal mines. In 1856 he was appointed resident engineer of the Huntington & Broad Top R.R., having charge also of the opening up of the Broad Top coal field, then new. While there, he came in frequent conference with J. P. Lesley, then state geologist of Pennsylvania. He also had charge of the building of the extension from Mt. Dallas to Cumberland. In 1875 the late Hon. Daniel J. Morrell persuaded Mr. Fulton to remove to Johnstown as mining engineer for the Cambria Iron Co., having charge of all the company's coal and iron-ore properties. Among his early duties was the determination of the coke to be used. The company had built a bank of Belgian ovens, but it was found that the coke made in these was structurally weak and would not stand the burden of the heavy Lake ores used in making bessemer pig. This experience gave Mr. Fulton a certain bias in favor of beehive coke and in later years he lent the weight of his great authority against the byproduct oven. Further experience, however, led him to change this opinion, but, as often happens, the first assertion was more widely circulated than the subsequent retraction, and Mr. Fulton was always quoted as an advocate of the beehive. He continued his investigations on the qualities of coke as a blast-furnace fuel, writing a number of papers which finally grew into the first volume of his work on the manufacture of coke. Later, he made a tour through Belgium, France and Germany, studying the methods of coke makers, giving his experience in the second volume of his work. In 1887 Mr. Fulton was promoted to be general superintendent of the Cambria Iron Works and a year later, general manager. In 1892 he resigned and engaged in the practice of his profession as a consulting engineer. In that capacity, he had charge of new works at Johnstown, at Lorain, Ohio, and in Nova Scotia, and visited Newfoundland and Porto Rico. He also, in partnership with Isaac Taylor, of Dunbar, bought a large tract of coking-coal land on the Redstone branch of the Pennsylvania R.R., which he owned for a number of years. Mr. Fulton aided Professor Lesley in making geological surveys of the counties of Cambria and Somerset for the Second Pennsylvania Geological Survey. For a number of years he was a member of the State Board of Health, and also of the State Forestry Commission, retaining the latter office until 1910. He was a member of the Johnstown Board of Health and took an active part in the city government. He was also a member of the American Philosophical Society. At the St. Louis Exposition in 1904, he was a member of the Committee on Mines and Minerals. Four years ago, on account of his age, he retired from his more active work, but still continued to do much consulting work. Few men have occupied as prominent a position as John Fulton and he was universally respected for his clear judgment and wide experience, holding almost the same position in the coal trade as John Fritz did in the iron trade. He leaves a widow, to whom he was married in 1855, and three daughters.

SOCIETIES

American Institute of Mining Engineers—The 112th meeting will be held in New York Feb. 14-17.

Canadian Mining Institute—The eighteenth Annual General Meeting of the Institute will be held at Ottawa, on Wednesday, Thursday and Friday, Mar. 1, 2 and 3, next. The Council has decided to limit the business sessions to five, namely, three on the first day, and two on the second day of the meeting. The annual dinner will take place on Thursday evening. On the third day, Friday, series of excursions will be arranged to points of interest in Ottawa, including the Mint, the Victoria Museum and the Government ore-testing laboratory and fuel-testing station. Most of the time usually allotted to the reading of papers will, on this occasion, be reserved for general discussions on specially selected topics. Of these one is "Flotation," to the symposium on which some notably informative contributions are expected. Another subject of extraordinary present interest, namely, the effect of the war on Canadian mineral industries, will be introduced by Prof. Alfred Stansfield, and Mr. Howells Frechette. "Mining Education" will also be discussed by Professor Gwillim and others.

INDUSTRIAL NEWS

The Moctezuma Copper Co. of Nacozari, Sonora, Mexico, has recently completed an aërial tramway of the Leschen heavy-duty friction-grip type, which is to be used for the disposal of tailings from its mill. This tramway is approximately 3,000 ft. long, having a rise in this distance of approximately 275 ft. and has a capacity of 50 tons of tailings

per hour. The carriers detach from the traction rope, in order to allow of loading from several spouts, but at the outer end of the tramway they pass around the terminal sheave without detaching. No labor is therefore required at the outer end. The carriers are automatically dumped by means of an aërial trip at any point along the line. The track ropes are ½-in. and 1-in. locked-coil. The traction rope is ⅜ in. diam. of the patent flattened-strand construction. The carriers are of 10-cu.ft. capacity, the average weight of the material per carrier being 1,250 lb. A Leschen heavy-duty friction-grip aërial tramway is being installed by the United Verde Extension Mining Co., Jerome, Ariz. This tramway will be 4,044 ft. in length and will have a fall in this distance of 594 ft. The tramway will be gravity operating and will have a capacity of 50 tons of ore per hour. The track ropes are 1⅜-in. and 1-in. locked-coil, the traction rope being ¾ in. diam. of the patent flattened-strand construction. The carriers are of 10-cu.ft. capacity.

TRADE CATALOGS

Hardsocg Wonder Drill Co., Ottumwa, Iowa. Catalog, Rock Drills. 34 pp., illus., 6x9 inches.

William Powell Co., Cincinnati, Ohio. Booklet, White Star Valves. 16 pp., illus., 3½x6 inches.

Lake Shore Engine Works, Marquette, Mich. Circular. Halby Shoveling Machine. Illustrated.

Alexander Milburn Co., Baltimore, Md. Catalog, The Wells Light and Heating Burner. 12 pp., 9x6 in., illus.

Terry Steam Turbine Co., Hartford, Conn. Bulletin No. 20. "The Terry Turbine." 8 pp., illus., 8½x11 inches.

Scranton Pump Co., Scranton, Penn. Bulletin No. 105, Triplex Plunger Pumps. 8 pp., illus., 6x9 inches.

Joseph Dixon Crucible Co., Jersey City, N. J. Booklet, "Graphite for the Boiler." 24 pp., illus., 3½x6 inches.

Wm. Ainsworth & Sons, Denver, Colo. Catalog B, Engineering and Surveying Instruments. 94 pp., illus., 6x9 inches.

Armstrong Cork and Insulation Co., Pittsburgh, Penn. Catalog, Nonpareil Corkboard Insulation. 152 pp., illus., 6x9 inches.

Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y. Bulletin No. 1015, Duratex Switchboard Cords. 18 pp., illus., 8x10 inches.

Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin No. 1632A, Centrifugal Pumps and Centrifugal Pumping Units. 46 pp., illus., 8x10½ inches.

Pelton Water Wheel Co., San Francisco, Calif. Circulars printed in Spanish, Portuguese and English showing adaptation of Pelton water wheels to different purposes. 4 pp., illus., 7½x10½ inches.

General Electric Co., Schenectady, N. Y. Bulletin No. 42,206, Curtis Steam Turbine Generators. 40 pp., illus., 8x10½ in. Bulletin No. 43,253, Series Luminous Arc Lamps, 16 pp., illus., 8x10½ inches.

The second edition of the Western Electric Year Book is out. It is known as the "Electrical Supply Year Book for 1916" and is similar to its predecessor. The current book continues the practice of a simple series of list prices upon which a basic discount applies, such a discount indicating to the holder of the catalog his approximate price for all the articles listed. One of the features of the present book is a section in which are listed all the sales helps that the company furnishes its agents gratuitously.

E. I. du Pont de Nemours Co., Wilmington, Del. Catalog, Du Pont High Explosives. First Section, Their Manufacture, Storage, Handling and Use. 128 pp., illus. 9x6 in. Second Section, kinds, grades and brands. 24 pp., illus., 9x6 inches. The first section of this catalog is devoted to very interesting descriptions of the manufacture and methods of testing high explosives. Methods of storing dynamite are described at length and working drawings are given of various types of manure, live or exhaust steam, and hot-water heated thaw houses. The method of making up primers and the method of charging bore holes and the best practice in the use of blasting caps are fully discussed. Various mining, construction and miscellaneous uses of high explosives are described, and a good collection of rules for storing, handling and using dynamite and blasting supplies are given. The second section is devoted wholly to the description of the different kinds, grades, and brands of explosives, giving the characteristics of each and the various uses to which they are especially adapted. Every mine superintendent ought to have copies of these two catalogs.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

AIR—Method of Controlling the Humidity of Air Under Pressure. Willis H. Carrier, Buffalo, N. Y., assignor to Buffalo Forge Co., Buffalo, N. Y. (U. S. No. 1,167,740; Jan. 11, 1916.)

ALLOYS—Process for the Production of Alloys of High Melting-Point Having Ductile Properties. Hans Kaiser, Augsburg, Germany, assignor to the Firm of Wolfram-Lampen Aktien Gesellschaft, Augsburg, Germany. (U. S. No. 1,167,827; Jan. 11, 1916.)

ALUMINOTHERMIC MIXTURES, Method of Producing. John H. Deppeler, Jersey City, N. J., assignor to Goldschmidt Thermit Co., New York, N. Y. (U. S. No. 1,168,061; Jan. 11, 1916.)

BLAST FURNACE. William P. Thornton, Knoxville, Penn., assignor to Riter-Conley Manufacturing Co., Pittsburgh, Penn. (U. S. No. 1,167,729; Jan. 11, 1916.)

BLAST FURNACE—Hot-Blast Stove. Karl L. Landgrebe, Ensley, Ala. (U. S. No. 1,168,014; Jan. 11, 1916.)

BLAST FURNACES—Method of Charging Blast Furnaces. Arthur J. Boynton, Lorain, Ohio. (U. S. No. 1,167,883; Jan. 11, 1916.)

CONCENTRATING TABLE. Michael J. Morley, Hayden, Ariz. (U. S. No. 1,167,799; Jan. 11, 1916.)

CONCENTRATION—Means for Concentrating Ores. Thomas A. Edison, Llewellyn Park, West Orange, N. J. (U. S. No. 1,167,638; Jan. 11, 1916.)

CONCENTRATORS—Riffle Table for Concentrating Apparatus and Method of Constructing the Same. Frederic B. Kollberg, Bisbee, Ariz. (U. S. No. 1,168,009; Jan. 11, 1916.)

CORROSION—Process for Rust-Proofing Iron and Steel. William H. Allen, Detroit, Mich., assignor to Clark W. Parker, Detroit, Mich. (U. S. No. 1,167,966; Jan. 11, 1916.)

CUPROUS SULPHIDE—Improved Process for the Recovery of Cuprous Sulphide from Ores and the Like. Metals Research Co., New York, N. Y. (Brit. No. 138 of 1915.)

CYANIDING—Process of Extracting Values from Ores. Hans Foersterling and Arthur Ludwick Halvorsen, Perth Amboy, N. J., assignors to The Roessler & Hasslacher Chemical Co., New York, N. Y. (U. S. No. 1,164,636; Dec. 21, 1915.)

DRILL—Mining Apparatus. George C. Wilthew, Mahanoy City, Penn. (U. S. No. 1,164,900; Dec. 21, 1915.)

EXCAVATING MACHINE. Charles B. King and Clarence B. Weston, Marion, Ohio, assignors to Marion Steam Shovel Co., Marion, Ohio. (U. S. No. 1,164,652; Dec. 21, 1915.)

FLOTATION—Method of and Apparatus for the Concentration of Minerals by Flotation. New Jersey Zinc Co., New York, N. Y. (Brit. No. 23,626 of 1914.)

FUEL—Process of Modifying the Ash Resulting from the Combustion of Powdered Fuel. William P. Barba, Philadelphia, Penn., assignor to The Midvale Steel Co., Philadelphia, Penn. (U. S. Nos. 1,167,470 and 1,167,471; Jan. 11, 1916.)

HEAT TREATMENT—Process of Protecting Metal Articles Heated by the Combustion of Powdered Coal. William P. Barba, Philadelphia, Penn., assignor to The Midvale Steel Co., Philadelphia, Penn. (U. S. No. 1,167,472; Jan. 11, 1916.)

LAMP—Miner's Lamp. Jacob S. Sherman, Staunton, Ill. (U. S. No. 1,167,942; Jan. 11, 1916.)

MELTING—Method of and Means for Melting Metals. Frank Shuman, Philadelphia, Penn. (U. S. No. 1,167,944; Jan. 11, 1916.)

MINE CARS—Safety Device for Mine Cars. Benjamin F. Fern, Scranton, Penn., assignor of one-half to Florence S. Fern, Scranton, Penn. (U. S. No. 1,165,659; Dec. 28, 1915.)

ORE-BIN-DOOR-OPERATING MECHANISM. Leland Clapper, Two Harbors, Minn. (U. S. No. 1,164,702; Dec. 21, 1915.)

PHOSPHORUS—Apparatus and Process for Oxidizing Phosphorus. Ingenuin Hechenbleikner, Charlotte, N. C. (U. S. No. 1,167,755; Jan. 11, 1916.)

PLACER-MINING MACHINE. Charles R. Dennison, Youngstown, Ohio. (U. S. No. 1,166,192; Dec. 28, 1915.)

POTASSIUM AND ALUMINUM SALTS—Process of Producing Soluble Salts of Potassium and Aluminum. Melville F. Coolbaugh, Rapid City, and Elwyn H. Quinney, Pierre, S. D. (U. S. No. 1,165,154; Dec. 21, 1915.)

PULVERIZER—Rotary Impact Pulverizer. Charles S. Lincoln, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (U. S. No. 1,166,698; Jan. 4, 1916.)

ROASTING—Horizontal Mechanical Furnace for Roasting. Paul Sarrasin, Dijon, France. (U. S. No. 1,167,118; Jan. 4, 1916.)

ROASTING—Mechanical Roasting Furnace. Knut Jakob Beskow and Arthur Ramén, Helsingborg, Sweden. (U. S. No. 1,166,654; Jan. 4, 1916.)

ROASTING—Ore-Roasting Furnace. John C. Simmons, Colorado Springs, Colo. (U. S. No. 1,164,761; Dec. 21, 1915.)

SEPARATION—Apparatus for Separating and Recovering Metalliferous Compounds and Gases from Liquids. Frank L. Wilson, Berkeley, Calif. (U. S. No. 1,167,460; Jan. 11, 1916.)

SEPARATION—Apparatus for Separating the Metallic and Rocky Constituents of Ores. Dudley H. Norris, San Francisco, Calif. (U. S. No. 1,167,835; Jan. 11, 1916.)

ZINC—Process for the Production of Zinc. Otto Baltin, Lipine, Germany. (U. S. No. 1,166,170; Dec. 28, 1915.)

ZINC OXIDE—Process of Making Pure Zinc Oxide. Waldemar Asef, Philadelphia, Penn. (U. S. No. 1,165,743; Dec. 28, 1915.)

Editorial Correspondence

SAN FRANCISCO—Jan. 19

Damages for Breach of Contract amounting to $57,085 is the basis of a suit at law brought by the Associated Oil Co. against the Palmer Union Oil Co. in the Superior Court at San Francisco, Jan. 18. The complaint recites that on Nov. 30, 1911, the two companies entered into an agreement whereby the defendant company agreed to supply the Associated with 262,000 bbl. of crude petroleum at 30c. per bbl., delivered at San Diego. The Palmer Union delivered 33,657 bbl. and then refused to complete the contract.

Extraordinary Weather has prevailed over almost the entire area of California and the Sierra. The heavy snows in the higher elevations and the rains in the foot hills and valleys were accompanied by gales of wind which developed into a small cyclone in the southern part of the state, doing great damage in the oil fields and other sections. Snow on the summit of the Sierra, at Truckee, measured 11 ft. and in the northwestern part of the state a number of mining camps were snowed in. Grass Valley and Nevada City were, on Jan. 16, still without water supply sufficient for even domestic demand. Owing to snow blockades resulting from repeated storms, it has been impossible to open the ditches which in some places were buried under 10 ft. of snow. A number of buildings collapsed under the weight of snow. Same or similar conditions obtained all through the mountain region, although definite information is not at present available. Virginia City reports this to be the worst storm in the past 25 years. Transcontinental freight traffic was suspended and passenger service delayed on both the Southern Pacific and the Western Pacific.

Mining Prospects in California for 1916 are exceptionally favorable so far as demand for mineral and investments in mines are concerned; the increased development and production of tungsten, manganese, magnesite, as well as copper and gold within the last half of 1915 has encouraged the mine operator and mine owner. The Mammoth and the Mountain Copper in Shasta County have largely increased their production. The Mountain Copper is reported to be extracting approximately 15,000 tons of ore per month which is nearly double the quantity handled in a corresponding period in 1914. When the European War broke out this company closed down both the mine and concentrator and smeltery, because it is a British company and the conditions were such that it was impossible to provide for continued operation at that time. The financial condition changed to the advantage of the company, and the new concentrating plant, which was about ready for commission when the war broke out and was rendered idle on that account, has been in operation in 1915 and the prospects are good for continued mining and treatment of ore. But with all these fine prospects for the copper and gold miner, there is the obstacle to overcome of increased prices of dynamite, quicksilver, cyanide, zinc shavings, etc. It is reported that 10% dynamite has advanced about $90 per ton in the past few weeks, commanding about $330 per ton, with 60% dynamite reaching $420 per ton; quicksilver as high as $130 per flask; and other chemicals have more than doubled in price since the outbreak of the war. The high price of copper is a compensation to the copper miner, but the gold miners are not compensated except in increased production, which all of them are not prepared to undertake on short notice.

Improvement in the Oil Situation in California is indicated by action of U. S. General Land Office in the Honolulu Oil Co. case, and in the general advance in California field prices announced by the Standard; the activity of the Shell interests, and the report that the Southern Pacific will establish a new pipe line which will not be a common carrier. In the Honolulu Oil Co.'s case the Land Office has found to be valid the claims to more than 2,000 acres of California oil lands in Midway field which had been withdrawn from entry by the Government in 1909. The lands comprise 12 quarter sections of a 17-quarter-section tract in the naval reserve. Four of these quarter-sections are charged by the Land Office to have been filed by dummy locators. This matter will be heard in California. The decision of validity of the claims is of great importance to all oil men who are in danger of conflicting with the Government regarding the withdrawal lands. It holds that every oil operator who in good faith occupied oil land at the date of withdrawal and was overtaken in the diligent prosecution of work leading to the discovery of oil or gas, and continuing such work until discovery, is protected in his rights regardless of the Taft withdrawal act. It sets forth that work done outside the physical boundary of oil claims, which is plainly intended to benefit such claims, is the work required by the Picket law to make the claim valid. The decision further holds that diligent prosecution of work is not to be narrowly construed as actual drilling for oil, but may be any work which is plainly necessary to develop the claim. The Honolulu began development in the spring of 1910 and its position in relation to the Taft withdrawal order was less favorable than of many companies that developed properties prior to the withdrawal order. It is believed that now patent will issue to all locators who have shown good faith in the prosecution of work. It is also believed that the decision will have an influence upon Congress favorable to the oil men who are contending over lands within the naval reserve.

DENVER—Jan. 19

The Michigan Mine, one of the old-time producers of Kokomo, closed down because of the excessive zinc penalties that prevailed on gold-silver ores some years ago, is operating with marked success, shipping at present about 25 tons per week and getting into shape for considerably larger production.

Weston Pass is about 10 mi., in an air line, southeast of Leadville. It is really a pass over the crest of the Mosquito Range. At times, for years, prospectors have reported finds of mineral in the vicinity but nothing of importance has resulted. Recently, however, miners have been shipping zinc-carbonate ore from the Ruby property via the railroad siding at Hayden. The ore is said to be of excellent grade and plans are being laid to develop the Ruby into a large producer.

French Gulch Dredging Co.—usually spoken of as the Reiling company—has had a most prosperous year at Breckenridge. It is said, on good authority that the regular tri-monthly cleanups during the second half of 1915 have averaged more than $11,000, which means a daily gold recovery of about $1,200. The dredging has been done in a bank more than 400 ft. wide and varying in depth to 45 ft. The boat is still operating and an effort will be made to continue throughout the winter. The Tonopah Placers' dredges have worked with but slight delays since the beginning of last spring.

Officials of Colorado City and Colorado Springs and the commissioners of El Paso County have filed a petition in the U. S. district court declaring the two idle plants of the United States Reduction and Refining Co. nuisances and asking the court to take action to abate them. The complaint states that the mills' tailing dump covers twenty-five acres, that the material is a fine dust that drifts on the streets and blows into houses, causing much damage. It is also claimed that the flying dust chokes pedestrians, damages goods in stores and is a "menace to the health and comfort of the community." The suggestion is offered that the court force the receiver of the reduction company, J. Arthur Connell, to place a heavy layer of dirt over the tailing. The general opinion is that this last move is another one in the long-drawn controversy between the United States company and the Golden Cycle Mining and Milling Co., whereby the latter company as endeavored to eliminate the United States company as a factor in the business of reducing Cripple Creek ores.

BUTTE—Jan. 20

Butte Companies Made Voluntary Raise in Wages, Jan. 14, when the following notice was posted at all the properties of the Anaconda company in Butte, Anaconda and Great Falls:

The Anaconda Copper Mining Co., in view of improved metal-market conditions, has decided that, without altering any existing contract or obligation, it will, as long as the average price of copper remains 20c. per lb. or more, increase 25c. per day the wages of all employees subject to the present profit-sharing or sliding wage scale at the mines in Butte and the reduction works at Anaconda and Great Falls, the price of copper to be determined in the same way and by the same quotations extending over the same periods as at present computed.

This increase is made effective as of Jan. 1, 1916, but shall apply only to wage settlements made on or after Jan. 15, 1916. The increase affects the wages of 25,000 men employed by the Anaconda, Butte & Superior, North Butte, Elm Orlu and Tim-

ber Butte companies, that have made similar announcements to their employees. This raise in the wage scale of Butte miners will mean a total increase in Butte's payroll of $130,878 per month. The rate prevailing in December was $4 per day for miners. As long as the price of copper remains above 20c., it will be $4.25.

It Is Particularly Significant that the raise came as a voluntary one on the part of the companies involved. It is now a year and a half since the labor troubles and dissensions in the ranks of the men that put an end to the power of the Western Federation of Miners in Butte. The companies had no part in the inception of those labor troubles. It was a revolt on the part of the miners themselves against the tyranny of the men who controlled the union. These divisions led the companies to take an independent stand. They could not recognize one faction of the men without incurring the enmity of the other and it ended by recognizing none and allowing the men to belong to any union or no union, as they chose. It was at that time that the companies announced that in spite of the divisions in the labor ranks, the old agreement made with the unions as to a sliding wage scale would be adhered to. When the war in Europe started and copper went down to 11c. per lb., and the production was curtailed 50%, the Anaconda and other Butte companies maintained the $3.50 per day wage scale. In the entire United States it is safe to say there cannot be found today a better satisfied, more loyal and more contented army of employees than those of the great mining companies of the Butte district. They are beginning to realize that the corporation is not acting on those narrow selfish lines that usually are credited to corporations by the labor agitators. Socialism has received a blow in Butte by this last voluntary wage increase that means its death knell. The contrast this winter with former winters in Butte is most marked; there are no soup houses nor bread lines; charity organizations have little trouble caring for the poor of the community.

SALT LAKE CITY—Jan. 21

Members of the Utah Chapter of the American Institute of Mining Engineers received notices requesting them to attend a citizens' meeting on the question of military preparedness. The notice was signed by L. S. Austin, who was appointed a special committee and who called attention to the interest the national organization is taking in the matter, urging that the local chapter do its share. The citizens meeting was held at the Commercial Club, Jan. 20, about 400 persons being present, the Utah chapter being well represented. Two hundred signed cards promising to attend a series of eight military lectures, to be given by the war department, and to attend a training camp to be held at Fort Douglas next summer, if possible. Various individuals and firms pledged themselves to pay the expenses of a total of 31 men at the camp, the amount not to exceed $30 per man; and others agreed to pay employees full wages while in camp. S. C. Park, former mayor and retired brigadier general of the Utah National Guard, presided. Talks favoring a training camp were given by W. G. Farrell, J. U. Giesy, W. P. Kirksey, F. B. Gallagher, N. D. Corser, E. Jensen, C. W. Whitley and D. C. Musser. Mr. Whitley as representative of the A. S. & R. said that this company was in favor of the idea, and would give substantial support. Mr. Whitley, speaking for the Utah chapter of the American Institute of Mining Engineers, called attention to the support given by the national organization to the citizens' camp and general preparedness movement. Mr. Whitley put his name down for ten men in the list of those offering to pay expenses of men at the training camp.

An Increase in Wages has been made in the camp of Bingham. The announcement of the increase by the Utah Copper Co. was made Jan. 20, saying that the increase went into effect Jan. 1, and the increase by the other companies will became effective Feb. 1. The Utah Copper notice states, that all day labor that has been paid more than $2.65 per day will receive an advance of 25c. per day, and all day labor that has been paid more than $2.65 per day will receive an advance of 25c. per day, and all day labor that has been paid $2.65 a day or less will receive an advance of 20c. per day—this increase to be effective as of Jan. 1, 1916, and to remain in effect while the average monthly price of copper is 20c. or more per pound, New York quotation. Another notice to the employees of the mills at Garfield reads: "The Utah Copper Co. has decided to increase the scale of wages at its mills at Garfield as follows: All common labor, working eight hours, will receive an advance of 15c. per day; all common labor working nine hours will receive an advance of 20c. per day, and all skilled labor will receive an advance of 25c. per day. This increase to be effective as of Jan. 1, 1916, and to remain in effect while the average monthly price of copper is 20c. or more per pound." There are approximately 3,500 men employed by the company at Bingham and at Garfield who will receive the advance in wages, the increase amounting to between $20,000 and $25,000 per month, by this company. Other Bingham companies effected are: The Utah Consolidated, employing 350 men; the Utah Metals Tunnel-Bingham New Haven, 160 men at the mine and mill; the Utah Apex, 200 men at the mine and mill; the Yampa, 50 men; the United States properties, 75 men; the Bingham Mines, 75; and 20 smaller companies and lessees, from four to 30 men each. The increase in wages by these companies will go into effect Feb. 1. The total number of miners working in the camp at the beginning of the year (including mills at Garfield), was in the neighborhood of 4,500. The new schedule means that skilled workmen will receive a flat increase of 25c. a day, labor working nine hours, 20c. a day; labor working eight hours in the mills, 15c. per day. The increase applies only to the mines and mills, and not to the employees of the Bingham & Garfield R.R. The silver and lead mines granted a flat increase of 25c. a day, going into effect Feb. 1, and did not make any stipulations as to the price of metals. The payrolls of these properties will be increased from $120 up to $2,000. For January the Utah Copper's payroll will be approximately $344,000. The last raise in wages in Bingham of 25c. a day took place Aug. 1, 1915, when copper reached 17 cents.

WALLACE, IDAHO—Jan. 15

Tungsten Continues to Absorb Attention at Murray, the center of the early-day gold mining in the Coeur d'Alenes. At the Golden Chest, which was successfully worked many years ago as a gold mine and still possesses extensive gold deposits, 17 men are now employed taking out tungsten ore. Shipments estimated at $40,000 have been made and the work in the mine has disclosed a much larger amount of scheelite than was at first anticipated. So important has the discovery of this ore in the old mine proved to be that it is announced that Samuel Green, of New York, owner of the property, will soon arrive for an indefinite period to give it his personal attention. The result of this rich find in the Golden Chest is seen in the widespread prospecting of the old placer diggings around Murray and on Trail Creek, where it is recalled that in the early days the placer miners were troubled with a heavy, cream-colored sand in their sluice boxes, the nature of which nobody understood then, but which is now believed to have been scheelite. Not much can be accomplished examining the old diggings now on account of the heavy snow, but the ground will be thoroughly tested in the spring and it is believed that rich discoveries will be made. The publicity that has been given to tungsten since the discovery in the Golden Chest, giving much information as to its characteristics and conditions under which it is usually found, has awakened much interest and a keen lookout is being kept for it by prospectors and miners in all parts of the district.

HOUGHTON, MICH.—Jan. 23

The Calumet & Hecla Smelting Plant at Hubbell is turning out copper at the rate of 440,000 lb. per day; the copper being shipped East by rail. The Calumet & Hecla interests have practically sold all the output of the subsidiaries as well as of the old mine for the first five months of the year. The output of the smelting plant at Hubbell is larger by 25% than ever before in the history of the Calumet & Hecla. The new large furnace, No. 23, designed to handle 150,000 lb. a day, has all steel up and work is progressing rapidly. This additional furnace, inclosed in an addition to the building where No. 21 and No. 22 are situated, will make the capacity of the Hubbell plant of the Calumet & Hecla the largest in Michigan and one of the largest in the world. In addition to this plant at Hubbell, the Calumet & Hecla interests control the big plant at Dollar Bay, where the bulk of the production of the subsidiaries is handled.

Lake Superior Copper Production will show a falling off of at least 2,000,000 lb. for January, 1916, compared to the figure for December, 1915. It is feared that the output for January will be closer to 20,000,000 than to 25,000,000, although productions for every month in 1916 ought to average more than 25,000,000 lb. of refined. Every mine is working at full tilt, with larger forces than ever before, with more mills and larger smelting capacity. But nature steps in and spoils the best-laid plans. For 17 days steadily the copper district of Michigan has been fighting one of the old-time Lake Superior blizzards, with a continuous hurricane wind, a steady fall of snow and the thermometer below zero. With railways it is utterly impossible to maintain steady service. Snow piles 25 and 40 ft. high on either side of the deep cuts are common. The storm is preventing the shipment of mine rock to the mills. Ordinarily it would not necessitate shutting down stamp heads; a storm of a few days can be cleared up in a day, but this continuous cold, continuous snow and continuous wind, have caused a great deal of trouble. At this writing there is no sign of abatement and some mills will have to shut down altogether if it keeps up a few days longer.

The Mining News

ALASKA

ALASKA GOLD MINES (Juneau)—Will issue another series of 10-year 6% convertible debentures; maturing Mar. 1, 1926, for principal sum of $1,500,000, to be known as "Series B," convertible at any time prior to maturity into stock of company at $30 per share, and redeemable at company's option on or after three years at 110% of par plus accrued interest. Mill is now treating about 4,000 tons per day and grade of ore is rapidly approaching average indicated by estimates based on earlier mine development and mill tests.

ARIZONA

Cochise County

COMMONWEALTH EXTENSION (Pearce)—Good shoot of ore struck in shaft at depth of 220 ft. New hoist recently installed; shaft going down 2 ft. per 8-hr. shift.

LEADVILLE (Courtland)—Over 300 tons of ore shipped in December to Douglas smelter. Over 100 men are employed in district, which shipped 1,400 tons last month.

MASCOT (Willcox)—Development on 300 level indicates orebody is much larger than first believed. Company is planning installation of concentrator and new power plant.

Gila County

WESTERN STAR (Payson)—Small shipment of $60 gold, silver, copper and lead ore made to International smeltery.

BOSTON & SUPERIOR (Globe)—Annual statement announces sulphide ores at and below 1,200-ft. level will be developed. Company has million and a half dollars' worth of oxidized ore developed above eighth level.

POWERS GULCH DEVELOPMENT (Rice)—Recent shipment of tungsten ore averaged 76.3% tungsten. Sample of ore sent to Bureau of Mines said to be highest ever assayed by government assayers. B. F. Crawford, John Hoffman and Matson brothers, owners.

Graham County

SAN JUAN (Safford)—Unwatering of the San Juan mine recently purchased by Phoenix capitalists is under way. Equipment is being overhauled preparatory to a resumption.

MORGAN & OWENS BROS. (Geronimo)—Made gold-copper strike in ledge in Hooker Cañon, 8 mi. east, across Gila from Geronimo. Pay streak of decomposed porphyry, 6 ft., shows free gold throughout. Lode 25 ft. wide has been traced over mile long.

Mohave County

BIG JIM (Oatman)—Crosscut on the 400 level proved width of vein at this point to 50 ft. Of this, 25 ft. is considered pay ore.

MOSS (Goldroad)—Crosscut recently made through 60 ft. of quartz. Drift being driven to determine extent and value of the vein. Work is being done by the Gold Road Mines Co.

GOLD ROAD (Goldroad)—Station is being cut on 900 level about 1,500 ft. east of No. 1 shaft, which was originally known as glory hole. An electric hoist is being installed and winze will be sunk to 1,400 level.

MAGNET (Hackberry)—West crosscut on 100 level has cut 8 ft. of ore assaying $25 per ton; hanging wall not yet reached. Situated in Gold Basin district, 45 mi. northerly from Hackberry; owned by Davis Garrett.

CYCLONIC (Hackberry)—Another Gold Basin property owned by S. C. Bragg, and operated under lease and bond by J. M. McLeod, of Los Angeles. Drifts going from bottom of 85-ft. shaft; 16-ft. vein assays from $7 to $35 per ton.

ORPHAN (Goldroad)—West drift on 40-ft. level of No. 2 shaft is following 3-ft. vein averaging about $300 per ton. West crosscut on 40-ft. level of No. 1 shaft has disclosed 35-ft. vein of quartz averaging $7.10 per ton. Has recently shipped sixth $600 bar of bullion to San Francisco mint.

MIDNIGHT (Chloride)—James Murray, of Butte, and G. S. Holmes, of Salt Lake City, have started work under lease and bond from owners, Kean and John St. Charles. North and south crosscuts will be driven from bottom of 200-ft. shaft. Seventy-foot vein is high in silver, lead, zinc and gold.

Pinal County

RAY-ARIZONA (Kelvin)—Leasers recently shipped car of copper ore to Hayden smelter.

RENFROW (Kelvin)—Renfrow group adjoining Troy-Manhattan on east has been bonded to J. C. Devine, of Ray, who has started active development.

Yavapai County

WICHITA PLACER (Prescott)—Recently installed pumping equipment on placer property on Lynx Creek. Is operating two hydraulic plants in gravel beds.

COMMERCIAL (Copper Basin)—Freight teams to Skull Valley are hauling but half a load at each trip on account of snow, which is 26 mi. deep in valley. Production consequently reduced to 50 tons daily.

CASH AND SNOOZER (Maxton)—N. H. Getchell has consummated deal whereby Wall Street capitalists purchased these two mines. Getchell will continue as superintendent. Test mill has shown satisfactory gold recovery.

CALIFORNIA

Amador County

ONEIDA (Sutter Creek)—Unwatering is progressing steadily. The 80-stamp mill of the South Eureka is operating on good ore.

VEITH HYDRAULIC (San Andreas)—This property on Sport Hill has been bonded to men who will undertake development. Mine paid well for a number of years by hydraulic process. There is reported to be milling rock in property.

PLYMOUTH CONSOLIDATED (Plymouth)—Preliminary report for December shows yield of $58,490 from 11,650 tons of ore milled, an average of $5.02 per ton. Operating expenses, $26,324; development, $5,421; net profit, $26,951. A. Burch, San Francisco, is manager, and James F. Parks is superintendent.

KEYSTONE (Amador City)—Semi-annual report for period ended Dec. 31, 1915, shows net yield $86,167 in bullion and concentrates, from 38,663 tons of ore milled, an average of about $2.23 per ton, after deducting freight and smelter charges. The 40-stamp mill lost only 5 days, 9 hr., 20 min., including time taken for general repairs and cleanup and one day without electric power. Largest proportions of ore milled extracted from 900, 1,000 and 1,200 levels; about 1,000 tons hoisted from 1,400 level, which was of better grade than on the 1,200. Large amount of development done on each level, disclosing evidence of improvement in grade of ore. Expenditures for the half year amounted to about $82,000, leaving a balance of $6,465. This property has been in almost continuous operation since 1852. About four years ago extensive and deep development was undertaken under management of C. R. Downs.

Eldorado County

TEDDY BEAR (Nashville)—Reported that 12-in. vein of "ribbon" quartz of high assay has been disclosed at a depth of 140 ft., in a winze next to hanging wall. Property with other claims was acquired by John W. Cover recently.

SHAN TSZ (Eldorado)—This property owned by Chinese merchants of San Francisco and managed by F. T. Hale, is operating steadily. It is equipped with three 20-ton roller mills, electrically driven.

Kern County

MILLER & MOESSER (Randsburg)—Three jigs in operation making 30 to 100 lb. tungsten concentrate per day from each jig. New ground recently started averaging 30 lb. per day and some rich ground run as high as 100 lb.

SUNSHINE (Randsburg)—After shutdown of about a month, on account of death of T. W. Atkinson, operations resumed. J. Jewett is working a lease. Will develop by shaft, opening up new ground sufficiently for the term of the lease. Good ore being stripped on 400 level and mill will be started on this ore.

Placer County

MOUNTAIN QUARRIES (Auburn)—Pacific Portland Cement Co. reported to have taken out 330,000 tons of limestone in the year 1915.

BIG OAK (Colfax)—Preliminary work of organization progressing. Company expects to be ready for operation early in the spring. Modern equipment and modern methods are contemplated.

San Bernardino County

TUNGSTEN AREA was recently increased by finding of a 200-lb. chunk of scheelite, at point 1½ mi. south from the nearest producing mines along Randsburg railroad. After crushing and jigging the piece produced about 200 lb. of good-grade ore. Shields and Anderson were the finders.

TECOPA CONSOLIDATED (Tecopa)—Silver and lead ore being mined and shipped from Gunsight.

REX PLASTER (Bissell)—Shipping 40 to 50 tons of magnesite per day to Los Angeles. Employ 20 men.

LOUISIANA CALIFORNIA (Goffs)—Producing gold, silver and vanadium. Shaft is down 900 ft. Installation of mill is contemplated. F. Leiser is superintendent.

PACIFIC COAST BORAX (Death Valley)—Lila C. mine has been abandoned, having been worked out; new deposit near Ryan is now under development and operation.

Shasta County

MAMMOTH (Kennett)—Employ 600 men; 650 tons of copper ore and 250 tons zinc ore produced daily. Zinc ores are run over sorting tables at smeltery and shipped to zinc smelteries in Kansas.

MOUNTAIN COPPER (Keswick)—Concentration and flotation plant at Minnesota station treating about 250 tons of ore per day and making high recovery. Mines are producing about 15,000 tons of copper ore per month, part of which is shipped to smeltery at Martinez.

BULLY HILL (Winthrop)—Reported that prospect for installation of zinc smeltery is good. It is understood that should company undertake smelting of zinc ores, it will also treat zinc ores produced by the Afterthought mine, situated east of Bully Hill on Little Cow Creek. Both properties have shown by development that they contain large tonnage of zinc ores. Bully hill has been experimenting with zinc smelting process for past two years, since closing down of copper smeltery by Forest Service, which was afraid that a lot of scrub timber would be lost to the people.

Sierra County

ALHAMBRA (Poker Flat)—Work suspended until spring, when stamp mill will be erected to crush large quantity of ore now mined and further development pushed with powder drills to be installed. John McFarlane in charge.

Tuolumne County

DUTCH-APP (Jamestown) — Arrangements made for installation of tube mill. Large amount of New York being done in remodeling milling plant. W. J. Loring is manager.

STARR KING (Sonora)—High-grade ore disclosed at the 80-ft. point below the 400 level, on contact of slate and limestone and is 3 ft. wide. R. C. Kennedy, of San Francisco, is owner.

COLORADO

Boulder County

GRAPHIC (Magnolia)—Development work resumed at this property by Bert Fairhurst. Tungsten ore of commercial value has been opened.

MOUNTAIN LION (Magnolia)—Pocket of rich molybdenum ore has been struck in this property. Vein is 18 in. wide. Development work is under direction of J. H. Horry.

NEW YORK GOLD MINES (Sunshine)—Has been equipped for systematic development which is now under way. Some tungsten deposits have been opened. E. D. Brooks is manager.

ST. ELMO AND MT. QUEEN (Nederland)—Situated about 1½ mi. northeast of Nederland, leased and bonded by R. W. Benadum to Andrew Nelson and associates. Lessees will at once equip and develop mines. Tungsten ore has been opened by recent development.

GRAND VIEW (Boulder)—Shoot of tungsten ore 18 in. wide opened on 160-ft. level for distance of over 30 ft. Same ore shoot also opened in 230 and 300 levels. Until recently this ore was regarded as "black iron" by miners and its real value has been overlooked for several years. Mine has been reopened and developed under direction of George Clemmer.

Clear Creek County

ARGO MILL (Idaho Springs)—Has decided to install flotation equipment to handle 100 tons of ore daily. Planned to have the improvements completed and ready for operation within 30 days. Being installed under the direction of A. R. Brown.

ONONDAGA (Georgetown)—Development on Ruler vein has opened 18-in. vein of smelting ore assaying $125 a ton in gold, silver and lead. Discovery made in east heading from Capital tunnel.

WEST EDGAR (Idaho Springs)—Being developed through Big Five tunnel by Nankervis and associates. A 3-in. streak of smelting ore has been opened in vein of payable milling ore. Ore from development has been shipped to Newton mill, where concentration of 7 to 1 results in product having value of $45 a ton. Present operations are 2,800 ft. from portal of tunnel and 150 ft. westerly on vein.

San Juan County

HAMLET (Silverton)—Mill recently destroyed by fire; loss covered by insurance and mill will no doubt be rebuilt. Mill had just been equipped with new flotation machinery.

San Miguel County

TELLURIDE SHIPMENTS during December were: Tomboy, 52 cars; Smuggler-Union and Black Bear, 48 cars; Liberty Bell, 11 cars; total, 111 cars. These shipments practically duplicate those made during previous month.

SUNSHINE (Ophir Loop)—This property, located across gulch from Butterfly-Terrible, leased to Henry Dorffeld, of Monte Vista, Colo., who has formed development company for purpose of opening property.

BUTTERFLY-TERRIBLE (Ophir Loop)—Lessees are carrying on development with encouraging results. Enough ore is being mined to keep 10 to 20 stamps in operation. Part of this supply is broken during development.

SHERIDAN (Telluride)—Small mill at portal of Sheridan crosscut destroyed by fire. Plant was owned and operated by owners of Carruthers Lease from Smuggler Union Mining Co. and produced about carload of concentrates a month. Loss estimated $10,000. Probable that lessees will rebuild mill in view of favorable developments underground and numerous recent expenditures for equipment, which is in good order.

Teller County

EL PASO (Victor)—Recent development opened body of $25 ore for length of 70 ft. on one of veins of Ajax system between 4th and 5th levels from Nicholls shaft.

PRINCE ALBERT (Cripple Creek)—Beacon Hill properties formerly owned by Prince Albert Mining Co., Ltd., which include Prince Albert, Beacon and Eureka properties, have been leased to Frank Vetter, who will form company to undertake development and operation of these mines.

DRAINAGE TUNNEL (Cripple Creek)—New water course cut last week resulting in an additional flow of 2,330 gal. per min., which increased total flow from 12,300 to 14,630 gal. per min. This is second heaviest flow encountered since driving of tunnel was resumed. All work in heading was suspended for several hours. Water level raised about 6 in. at El Paso shaft station at tunnel level.

IDAHO

Shoshone County

RED MONARCH (Beaver)—Carload of machinery for Red Monarch mine, on North Fork of Cœur d'Alene River, taken to Brunn's Crossing, whence it will be freighted to mine by teams. Compressor building at mine nearly completed and 20-drill compressor will be installed at once.

ROANOKE (Kellogg)—Under lease to John Grenfel, who has just shipped 44 tons of ore that runs high in lead and silver. Property quite extensively developed many years ago by tunnels and shaft, 300 ft. deep, showing considerable commercial ore. Lessee preparing to hand-jig large amount of low-grade ore. At meeting of stockholders this week proposition taken up to sell property to local operating company.

NATIONAL (Mullan)—Returns from shipments of concentrates netted over $90 per ton. Shipping more than four cars per month with one shift in mill. Plan to put on another shift with improved facilities for conveying ore from mine to the mill, the electric tram a mile and a half long at present not being equal to the task. Ore on 1,200 level shows gratifying improvement both in extent and values. Ore runs about 2 oz. silver to a unit of copper.

AURORA-SAMPSON—H. E. & M. (Wallace)—Consolidation of Aurora-Sampson and H. E. & M. consummated this week on an equal basis. New company to be formed with 2,000,000 shares, 500,000 to go into the treasury and the balance to be divided between the two original companies on a basis of two shares of old stock for one of new. Both properties developed through main tunnel of H. E. & M., which also has mill of 100 tons capacity, built last year, but mine is short of ore to keep it running. Promising body of galena ore recently encountered in Aurora-Sampson, 2 ft. of which is of shipping grade. Development work now in progress by new company.

MICHIGAN

Iron

OGLEBAY, NORTON & CO. (Crystal Falls)—Three drills are working on option near Fortune Lake. Churn drills were used here before, but results were not satisfactory.

HOLMES (Ishpeming)—This name of new mine being opened by Cleveland-Cliffs Iron Co. It adjoins Oliver Iron Mining Co.'s Sect. 16 mine. Shaft work was started this week. Most of equipment is on ground.

MORRIS (Ishpeming)—Another drifting record was made in January. Motor-size drift was extended 468 ft. during month. Only two drills are working in heading. Rock is hard and has to be trammed long way to shaft. Men worked 16 hours out of every 24.

M. A. HANNA CO. (Crystal Falls)—This company and Cole & McDonald will put down joint diamond drill hole on line between Sects. 30 and 19-43-32; to north lies Ravenna mine; to south is the Odgers. It is intended to cut through slate to country rock and ascertain if there is any formation capped by slate. Information will be valuable to both companies.

MINNESOTA

Cuyuna Range

CROFT (Crosby)—Superior, Wis., interests have begun drilling operations on property adjoining Croft mine to the east, in an endeavor to locate continuation of Croft's deposit of bessemer ore, practically the only bessemer ore on the Cuyuna Range thus far.

Mesabi Range

FOWLER (Aurora)—Will shortly be reopened by company organized for purpose, named Fowler Mining Co. Was operated by Jones & Laughlin Steel Co., but abandoned some time ago.

MISSISSIPPI (Keewatin)—Activity at surface plant, company houses, etc., indicates early resumption of operations at this underground property, although no announcement has been made by operators.

OLIVER IRON MINING (Hibbing)—Excavation under way for 4-mi. spur connecting Hull-Rust and Sheridan pits. The Oliver company has approximately 1,000 men and seven steam shovels working in above and Sellers pit. High winds and heavy snows, accompanied by subzero weather, have tied up all operations. Temperatures ranging down to 52° below zero reported on the range.

MONTANA

Broadwater County

KEATING GOLD (Radersburg)—On account of delay in proposed railway into Radersburg district, company is considering construction of concentrator at its property to treat large tonnage of low-grade ore blocked out, carrying $2 to $10 in gold. High cost of hauling by team over 11-mi. road permits only highest grade of ore to be shipped to smelters at profit.

Lewis and Clark County

BARNES KING DEVELOPMENT (Kendall)—Reported from Helena that company has taken bond and lease on Parker and Brownlow group of claims in Rimini district.

Silver Bow County

ANACONDA (Butte)—Owing to severe cold, causing ore to freeze up during transportation to smelters, all of company's mines were closed for several shifts during week.

BUTTE & GREAT FALLS (Butte)—Shaft is down over 400 ft. Sinking is proceeding at rate of 90 ft. per month. Company has installed up-to-date electric equipment, including hoist good for depth of 1,500 ft.

BULLWHACKER (Butte)—Syndicate that took over Bullwhacker property under lease is not shipping. Preparations being made to put existing leaching plant into operation and handle ore directly by electrolytic process.

ELM ORLU-BUTTE & SUPERIOR (Butte)—Judge Bourquin in the U. S. District Court has rendered a decision in the Elm Orlu-Butte & Superior suit over the Rainbow lode. Both sides interpret the decision as a sweeping victory.

BUTTE-BALLAKLAVA (Butte)—On 1,800 level orebody has widened to 24 ft. and carries on an average 3% copper. Output temporarily reduced to 150 tons per day, but will be increased to 350 as soon as new orebody on 1,800 level is blocked out for stoping.

TUOLUMNE (Butte)—Contemplated closing down of mine postponed by directors, who have decided to keep mine in operation as long as ore returns will pay for operating expenses. It is said that negotiations have been opened for sale of Tuolumne to Anaconda or North Butte.

Sweetgrass County

JOHN D. FENWICK, of Harlowtown, reports that about 100,000 acres of land have been filed on for oil prospecting in country south of Harlowtown. Thousands of acres have also been leased from farmers. There are no oil-producing wells in district, but one well was sunk last fall to 250 ft. when broken tools stopped operations.

NEVADA

Storey County

ANDES (Virginia)—Saved 25 cars of ore from stope on intermediate level.

COMSTOCK PUMPING ASSOCIATION (Virginia)—Pumps at north end holding water at all points.

CROWN-POINT BELCHER (Gold Hill)—Saved 247 cars mill rock from No. 2 stope, 1,600 level. Jacket mill crushed ore two days only on account of storm; received 76 tons dump rock and 101 tons of mine ore. Shipped bar bullion.

MEXICAN (Virginia)—Prospecting drifts on 2,500 and 2,700 levels in porphyry and quartz of low assay. Mexican mill crushed 407 tons custom ore, averaging $24.15, and gross $9,800.

UNION (Virginia)—Extracted 324 tons of ore, gross assay $8,600, as follows: No. 2 stope, 162 tons, averaging $39.52; No. 3 stope, 130 tons, $11.12; No. 4 stope, 42 tons, $27.35. Union shaft reopened 20 ft., to the 90-ft. point below 2,000 station.

SIERRA NEVADA (Virginia)—Winze on 2,500 level in ore averaging $27. West drift in vein material of low assay. Raise in old 2,400 level stope in ore sampling $16 to $50. Saved 49 ton from 2,400 level averaging $16.95 and 15 tons from 2,500 level winze averaging $27.86.

OPHIR (Virginia)—Central tunnel 250 level and north drift repairs, caught up old stope over south drift. Saved 235 cars of ore from stopes and milled 22 tons. Ophir & Con. Virginia joint west crosscut on 2,700 level in good looking formation believed to be Hardy vein; clay and quartz streaks. Storm interrupted for two days.

NEW MEXICO

MOGOLLON MINES (Mogollon)—Company is sinking to greater depth.

ALBERTA MIN. AND DEV. (Mogollon)—After long period of inactivity, company is making preparations to resume work. William Johns is superintendent.

MAMMOTH MILL (Pinos Altos)—Oscar Long and J. E. Trotter, of Hurley, have been making extensive tests of ores in Pinos Altos district with object of treating them together with their own ores, and propose turning old Mammoth into custom mill, at an expenditure of $20,000 for that purpose. Mill has 10 stamps, Huntington mill, two Wilfley tables and Blake crusher.

PINOS ALTOS M. AND M. (Pinos Altos)—Company is employing 50 men in mines and mills on 18 claims leased and bonded from the Savanna Copper Co. Ore is complex, carrying copper, gold, silver, lead and zinc. Specimen valued at $1,500 won prize at San Diego. Huff concentrating machine separates gold-silver-lead concentrates worth $60 per ton; copper-iron, $60; and zinc concentrates worth $50 per ton. Total recovery estimated at 60 to 65%. I. J. Stauber, manager.

Lincoln County

WHITE OAKS MINES CON. (White Oaks)—Company shipped 5 tons tungsten concentrates by express to Eastern market. Recovering tungsten from old Homestake mine; also making preparations to operate Old Abe property, in which tungsten has recently been found. Stock pays monthly dividends, although company has been operating 3 months.

Otero County

PROVIDENCE (Jarilla)—New strike of high-grade cuprite ore is reported. Manager Thomas M. Stanton is making daily shipments to El Paso smelter.

GARNET (Jarilla)—J. P. Hutchinson is opening up new orebodies; will begin stoping soon as new hoist is installed. Seven-ton motor truck will haul ore from bins over 3,000-ft. graded road to loading station on new spur of E. P. & S. W. Ry.

Socorro County

SOCORRO MINES (Socorro)—Running full; over 200 men employed; turning out 40 bars silver-gold bullion every month.

TENNESSEE

Polk County

TENNESSEE COPPER (Copperhill)—Miners went on strike Jan. 18 for an increase in wages. The mines at end of first week remained closed, and the furnaces were blown out, owing to lack of ore, though smeltermen did not join strike; some units of the acid plant are still in operation and will probably remain so.

UTAH

Beaver County

CEDAR-TALISMAN (Milford)—Zinc ore being opened on 400 level and is extending to depth.

PALOMA (Milford)—Six feet of ore of good grade carrying silver, copper and lead are exposed in bottom of shaft, which has been sunk 400 ft. on contact between limestone and monzonite, and which will be continued another 100 ft. Arrangements have been made to reduce bonded indebtedness from $15,000 to $7,500. Compressor has been ordered.

CREOLE MINING (Milford)—State Senator George H. Dern and C. C. Griggs, superintendent of the May Day mine at Tintic, have recently taken an 18 months' lease on this property. They have crew of men at work preparatory to starting shipment of ore. Lessees are to equip property with all necessary mining machinery and they expect to have first carload shipment on market within two weeks after active mining operations shall have begun. They are to pay 35% royalty on all ores shipped.

Juab County

TINTIC SHIPMENTS for the week ended Jan. 7 were 114 cars.

UTAH MINERALS CONCENTRATING (Eureka)—This company will treat dump of May Day company; contains 50,000 tons, about 30,000 tons of which has been cyanided by Griggs, Castleton & Carter mill, after treatment in mill of May Day Mining Co. Lower-grade tailings not cyanided. It is expected to treat about 2,500 tons monthly and a fair recovery of lead is expected.

Salt Lake County

CONGOR (Bingham)—Drifting is being done to south on fissure from near face of 4,048-ft. tunnel of Bingham-Montana-Bingham. Streaks of ore running very high in copper have been encountered.

BINGHAM MINES (Bingham)—Earnings from this company's mines in Bingham amounted to $86,000 for 11 months of 1915, compared to $68,281 previous year. In addition received $104,250 dividends from Eagle & Blue Bell, owned largely by this company.

MICHIGAN-UTAH (Alta)—New development work outlined includes driving Copper Prince tunnel about 500 ft. to reach intersection of Grizzley and another fissure between contact of white limestone and black shaley limestone. Triangle Leasing Co. is working ground above tunnel and making shipments.

UTAH METAL AND TUNNEL (Bingham)—Following death of E. P. Jennings, consulting engineer, and resignation of W. A. Barnes, superintendent, C. H. Doolittle, formerly superintendent of Bingham-New Haven, has been made general manager, Bingham-New Haven having been absorbed by Utah Metal. Production is being carried on at rate of 400 tons of ore and concentrates daily, Utah Metal stope furnishing about 120 tons of first-class ore, and the remainder coming from Bingham-New Haven side of property.

Summit County

DALY WEST (Park City)—In order to overcome water shortage due to cold weather, pumps will be installed on 1,200 level and water pumped from this point to mill. At present 25 men are being worked on development.

NEW QUINCY (Park City)—At annual meeting, Jan. 11, following directors were elected: W. S. McCornick, W. Mont Ferry, A. L. Thomas, W. R. Hutchinson, F. B. Cook, F. J. Hagenbarth, Herman Bamberger. Resolutions were adopted authorizing more extensive development work.

THREE KINGS (Park City)—W. R. Elliott, president of company, has been made general manager and Joseph Kemp, superintendent. Drifting is being done to south from shaft on 540 level for contact of limestone with underlying Ontario quartzite. Work, which is crosscutting the beds, will crosscut any northeast mineral-bearing fissures, such as have been responsible for ore in adjoining Silver King Coalition and Silver King Consolidated.

CANADA

Ontario

GIFFORD (Cobalt)—Is to be reopened.

FOLEY O'BRIEN (Porcupine)—Mine will be reopened.

STANDARD (Porcupine)—Has been sold. Property will be worked again.

MALOUF (Sesekinika)—This property has been sampled by Canadian Mining Corporation.

LA ROSE (Cobalt)—Production of 1,154,000 oz. for 1915 was greater than estimated ore reserves at beginning of year.

KEORA (Porcupine)—Is to be reopened by New York interests. Two small payments have already been made on property.

CROESUS (Munro Township)—Several tons of equipment for air-compressing plant being brought in from Badger mine in Cobalt district.

TECK HUGHES (Kirkland Lake)—Shareholders have authorized issue of $500,000 7% five-year bonds, of which $100,000 will be offered to shareholders at 85. Money will be used to build mill and install plant.

GREEK STRIKE (Boston Creek)—A. M. Scott, J. P. Bickell and associates have purchased this property on which spectacular find was made on patented lot No. 3665, Boston Township. Ore is sulphide showing free gold.

SMITH-LABINE (Sesekinika) — Development of these claims by Kerr Lake Mining Co. has been retarded by difficulty of getting sufficient water for boiler. There are 21 veins showing either free gold or tellurides; shaft is down 15 ft.

McINTYRE (Porcupine)—Mill capacity will shortly be increased to 450 tons a day. Report for quarer ended Dec. 31, 1915, shows tons milled, 26,160; average value, $7.39; recovery, 94.52%; operating costs, $108,748; operating profit, $75,485. On 700 level diamond drill penetrated orebody at 750 ft., showing 19 ft. of ore averaging $18 a ton.

MEXICO

Hidalgo

CORTEZ ASSOCIATED MINES (Zimapan)—In order to finance development of Sirena property, a new company, known as Antimony Corporation, organized with capital of 100,000 shares of preferred stock, par value $5, and 100,000 shares common stock, par value to be determined later; 40,000 shares of which will be offered Cortez Associated Mines in payment for Sirena group. Mr. Chas. F. Rand, of New York, formerly with Spanish-American Iron Co., will be president of new corporation.

The Market Report

Metal Markets

NEW YORK—Jan. 25

All of the markets were stronger and advancing during the last week, the sharp rises being in the cases of copper and lead.

Owing to the closing of our office and printery on Wednesday, Jan. 26, out of respect to the late John A. Hill, president of our company, we have had to go to press this week one day earlier than usual and our record of the markets ends with Tuesday, Jan. 25. Our report of next week will begin with Jan. 26.

Copper, Tin, Lead and Zinc

Copper—On an increased volume of business, this market rose further day by day. The major part of the business was for April and later deliveries, producers having but little to supply this side of April. Domestic consumers were the largest buyers of copper for April and nearer delivery. Producers were able to sell liberally for second-quarter delivery and made some sales of third-quarter. The demand from France continued large, and there was a little better buying from England than there was in the previous week.

Producers are making a difference of ¼@½c. per lb. between the prices for copper for earlier or later delivery. The talk about copper selling at 27@30c. a lb. that was made in some of the newspapers last week was nothing but moonshine.

The following is a copy of the order issued by the British government setting a £100 limit on certain copper purchases:

"I am directed to inform you that the minister of munitions considers it desirable to exercise a closer check upon the purchases of copper made by contractors to his Majesty's government for the purpose of carrying out munitions orders.

"I am to request, therefore, that from the date of this circular you will observe the following rules in regard to such purchases:

"(1) Orders up to and not exceeding 50 tons may be placed in the usual way without reference to the ministry.

"(2) No order for 'best selected' or 'electrolytic' brands of copper should be placed at prices exceeding £100 per ton, without first consulting the director of materials."

Copper Sheets, base price is 31½c. per lb. for hot rolled and 32½c. for cold rolled. Usual extras are charged and higher prices for small quantities. Copper wire is 26½@26¾c. per lb. at mill.

Copper Exports from Baltimore for the past week were 3,136,995 lb. to London, and 9,498,619 lb. to Havre; 12,635,614 lb. in all.

Tin—A good business was done in this metal, on the strength of which the price advanced a little, but otherwise the market was devoid of any particular features of interest.

Shipments of tin from the Straits for the year ended Dec. 31 were 65,240 long tons in 1914 and 68,079 tons in 1915; increase, 2,839 tons.

Tin production of the Federated Malay States for the year ended Dec. 31 was 36,782 long tons in 1914 and 34,896 tons in 1915; decrease, 1,886 tons.

Lead—Before the close of our last week of record, the St. Louis market had stiffened up in such a way as foreshadowed a general advance in lead. By Jan. 20 independent producers were able to sell in the New York market at better than the price of the A. S. & R. Co. During the afternoon of Jan. 21 the A. S. & R. Co. advanced its price to 6.10c., New York. Since then the market has been firm at that price, a good business being reported by all of the producers.

Spelter—The price for this metal has risen to 18½c. for spot and near-by, shading off about ½c. a month up to the end of March, spelter for February delivery being about 18c., and for March delivery about 17½c. For later deliveries the price goes off still more. The volume of business done for spot and near-by deliveries was relatively trifling; for the ensuing three months it was not very large, the major part of the business—some thousands of tons—transacted during the last week being for the second quarter. The price realized for that delivery was about 15½@15¾c. At the close of the week about all of the producers were sellers of second-quarter spelter at 15¾c.

Arrivals at Baltimore for the week included 8,454 tons zinc concentrates from Port Pirie, Australia.

Other Metals

NEW YORK—Jan. 26

Aluminum—The market is quiet with fair sales, but no pressure on either side. Quotations are 54@56c. per lb. for No. 1 ingots, New York.

DAILY PRICES OF METALS IN NEW YORK

Jan.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
20	4.7600	56⅞	23⅞ @24	41½	5.90 @5.95	5.80 @5.85	16.75 @18.50
21	4.7613	56⅞	24 @24¼	42	5.90 @6.10	5.82½ @6.02½	16.75 @18.50
22	4.7613	57⅛	24¼ @24¼	42	6.10	5.95 @6.02½	16.75 @18.50
24	4.7613	57⅛	24¼ @25¼	42¼	6.10	5.95 @6.02½	16.75 @18.50
25	4.7600	57⅛	25 @25¼	42¼	6.10	5.95 @6.02½	16.75 @18.50
26	.....	...	.....	...	.....	.....	.....

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Jan.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
20	26 1/16	87½	87½	117½	25.02	177½	177½	31½	6.76	88	18.73
21	27	89	88¾	118	25.12	178¾	179¼	31¼	6.65	90	19.16
22	27 3/16	.....	.....	.....	.....	.....	....	.....	.....	....	....
24	27 5/16	92	90¾	120	25.50	180	180½	31½	6.76	92	19.58
25	27¼	91½	90½	120	25.50	179	179½	31½	6.79	92	19.58
26	....	....	....	....	.....	....	....	....	....	..	.....

The above table gives the closing quotations on London Metal Exchange, All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £ 15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Antimony—Business has been moderate, but prices firm, with little change. Chinese and other ordinary brands are sold at 42½@44c. per lb. Cookson's is held at 56c. Futures are quiet.

Nickel—The market is steady and business is good. Prices are 45@50c. per lb. for ordinary forms, with 5c. per lb. premium for electrolytic metal.

Quicksilver—Supplies are still very scarce, and prices have reached by far the highest level on record. New York quotation for large lots is $260@265 per flask of 75 lb.; while small lots have sold as high as $300 per flask. London price is unchanged at £16 15s. per flask.

EXPORTS AND IMPORTS

Exports and Imports of Secondary Metallic Products in the United States 10 months ended Oct. 31, in pounds:

	Exports		Imports	
	1914	1915	1914	1915
Copper sulphate	7,231,183	10,300,131	.....	.....
White lead	15,287,767	20,230,912	.....	.....
Zinc oxide	26,481,061	34,280,911	.....	.....
Zinc dust	190,792	371,368	3,526,382	1,337,127
Zinc dross	3,385,314	8,329,346	.....	.....

Exports of zinc dust are all reëxports of foreign material.

Gold, Silver and Platinum

NEW YORK—Jan. 26

Gold—Another shipment of gold has gone to Argentina this week, making $2,500,000 shipped lately to that country. It is said that these shipments represent American investments there.

Platinum—There is nothing new in this market. Supplies are scarce and dealers hesitate about quotations. A little business has been done at a range of $85@95 per oz. for refined platinum.

Silver—The market shows a slight advancing tendency. The withdrawal of gold from circulation abroad has an influence in creating demand for silver to take the place, to some extent. While there is no especial inquiry from India at present, supplies being absorbed by continental buying.

Coined Silver in the United States Jan. 1, 1916, is estimated by the Treasury Department as follows: Standard dollars, $568,271,655; subsidiary coins, $189,128,969; total, face value, $757,400,624. Of the standard dollars $485,708,663 are held in the Treasury against silver certificates outstanding.

Imports of silver at San Francisco 11 months ended Nov. 30 were $2,808,841, against $1,079,062 in 1914. Exports of silver for the 11 months were $6,797,968, an increase of $1,515,223 over the previous year.

Zinc and Lead Ore Markets

JOPLIN, MO.—Jan. 22

Blende, high price $122.40; base per ton 60% zinc, premium ore $120; medium grades $112@107, and lower grades down to $100; calamine, per ton 40% zinc, $80@75; average selling price, all grades of zinc, $111.02 per ton. Lead, high price $82; base per ton 80% metal content $76@81; average selling price, all grades of lead, $77.42 per ton.

SHIPMENTS WEEK ENDED JAN. 22

	Blende	Calamine	Lead	Values
Totals this week	11,695,550	863,640	1,557,350	$757,420
Totals this year	35,461,630	3,492,810	5,695,220	2,229,520

Blende value, the week, $658,700; 3 weeks, $1,889,270.

Calamine value, the week, $38,440; 3 weeks, $126,710.

Lead value, the week, $60,280; 3 weeks, $213,540.

The severe cold continued over the first three days of this week, still keeping calamine operators idle, and some tailing mills, but on Thursday it broke with rains continuing all day and night, making loading all but imposible Thursday and Friday. Strong buying all week advanced the market to $120 base on Friday. Buyers were very active in loading the first three days of the week from bins of ore purchased last week, and some of this week's purchases were loaded today.

NEW YORK—Jan. 26

On the surface the iron and steel markets are rather quieter, but they are fully as active as ever, under the spur of urgent demand.

The main trouble with the mills just now is the delay in transportation. Some of the embargoes on freight in the East have been lifted, but others are still in force, and in local trade some shortage of cars has developed. This is affecting deliveries of coke to some extent, and this is rather a serious matter.

The pig-iron market continues strong and active, with many sales of foundry and some large transactions in basic iron.

PITTSBURGH—JAN. 25

The marked feature in the situation just now is the transportation question. We hear of some letting up on the embargoes in the East, but locally the situation is worse than it has been. Mills are beginning to suffer from an insufficient car supply for deliveries, and the effect of this must be to restrict production. A sudden shortage of cars in the coke trade has also developed on the last few days.

Prices continue to advance this week on wire and pipe. The adjustment of wages still goes on, and is now pretty nearly general through the trade. Orders for new cars are still coming in, the number contracted for this year up to Jan. 22 being 17,500 in all.

The United States Steel Corporation has decided to spend $11,000,000 for improvements and extensions of work. This will include $3,000,000 for byproduct coke ovens at the Carnegie works at Youngstown, Ohio.

OTHER ORES

Manganese Ore has been bringing high prices, chiefly because of the high ocean freight rates that have to be paid. A recent sale of Indian manganese ore is said to have cost the buyer 65c. per unit at tidewater. Sales of Cuban manganese ore are reported at 50c. per unit at tidewater.

Tungsten Ores are bought by the Vasco Mining Co. at Nederland or Boulder, Colo., under a new schedule, which begins at $21 per unit for 3% WO_3, advancing gradually to $25.50 per unit for 10% ore; $30.50 for 20%; $35 for 30%; $40 for 40%; $45 per unit for ore 50% or over. At this price 60% ore brings $2,700 per ton.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier" at 420,521 short tons; shipments, 410,189 tons. Shipments from the Greensburg and upper Connellsville districts were 44,016 tons.

Coke prices in the Connellsville region have been irregular and spot coke has advanced sharply. This is due to the scarcity of labor and the bad weather interfering with production and to the transportation delays cutting down shipments.

Coal and coke carried on the Pennsylvania R.R. lines east of Pittsburgh and Erie were 6,573,357 short tons, being 1,504,753 tons more than in December, 1914. For the year ended Dec. 31 the tonnage was:

	1914	1915	Changes
Anthracite	11,031,708	10,961,660	D. 70,048
Bituminous	44,756,905	44,588,789	D. 168,116
Coke	6,496,312	12,020,572	I. 2,524,160
Totals	65,284,925	67,570,921	I. 2,285,996

The total increase in 1914 was 3.5%; all the gain being in coke.

Chemicals

NEW YORK—Jan. 26

The general market is fairly active and is inclined to be stronger, at advancing prices.

Arsenic—There is more inquiry and the local market is much firmer. Some sales are reported as high as $5 per 100 lb. for spot, and there is no shading from this figure.

Copper Sulphate—The market is still uncertain and prices are higher. Sales have been made at $22.50@23 per 100 lb. for carload lots, with the usual differential for smaller orders.

Nitrate of Soda—A United States consular report from Antofogasta, Chile, says that during November, 1915, the production of nitrate of soda in northern Chile amounted to 5,201,165 quintals, or 527,398,131 lb., compared with 2,659,875 quintals for the same month in 1914, and 4,885,869 quintals in 1913. The exports during November were 3,310,108 quintals, or 335,644,951 lb. The lightness in shipments during November is attributed to the lack of vessel room due to the interruption of the Panama Canal.

A new company—Cia. Salitrera, "Pedro Perfetti"—with offices at Valparaiso, has been formed to operate several oficinas that have been idle for some time. It has a capital of $3,406,550. It will operate the oficinas Flor de Chile and Tricolor in the Department of Taltal, Province of Antofagasta, and Maroussia, Tres Marias and California in the Province of Tarapacá. The combined capacity of the five oficinas is about 200,000 quintals per month.

Prices are firmer and the current quotation is $3.50@3.75 per 100 lb. for both spot and futures.

Sulphuric Acid—Exports of sulphuric acid in October were 8,561,147 lb. For the 10 months ended Oct. 31 the total exports were 8,068,743 lb. in 1914, and 71,997,192 lb. in 1915; an increase of 63,949,347 lb. The current offerings of acid are small and prices nominal.

Assessments

Company	Delinq.	Sale	Amt.
Albany Lead, Ida	Jan. 20	Feb. 19	$0.005
Andes Silver, Nev.	Jan. 21	Feb. 11	0.02
Atlantic, Ida	Jan. 21	Feb. 21	0.005
Baltimore Cons., Utah	Jan. 11	Feb. 11	0.002
Beaver Copper, Utah	Jan. 31	Feb. 21	0.005
Bellerophon, Utah	Jan. 8	Jan. 29	0.005
Big Elk, Ida	Jan. 25	Feb. 15	0.001
Challenge Cons., Nev.	Jan. 11	Feb. 1	0.05
Deer Creek C. & G., Utah	Feb. 5	Feb. 26	0.005
Emerald, Utah	Jan. 15	Feb. 12	0.00½
Emerald, Utah	Feb. 15	Mar. 11	0.00½
Emerald, Utah	Mar. 15	Apr. 11	0.00½
Empire M. & D. Ida	Jan. 15	Feb. 15	0.005
Enterprise, Ida	Feb. 4	Feb. 16	0.002
Giant, Nev	Jan. 29	Feb. 12	0.0025
Gold Mt. Champion, Utah	Jan. 21	Feb. 8	0.0025
Hale Norcross, Nev	Jan. 25	Feb. 15	0.03
Idaho-Nevada, Ida	Jan. 7	Feb. 1	0.002
Imlay, Nev	Jan. 7	Feb. 8	0.01
Independence, Utah	Jan. 20	Feb. 14	0.001
Laclede, Ida	Feb. 4	Feb. 28	0.003
Lehi-Tintic, Utah	Jan. 15	Feb. 5	0.002
Lucky Swede, Ida	Jan. 11	Feb. 11	0.002
Massasoit, Utah	Jan. 13	Feb. 23	0.015
M. & P. Gold, Utah	Feb. 7	Feb. 21	0.0025
McKinley Gold, Ida	Jan. 28	Feb. 24	0.0005
Mexican Nev	Jan. 25	Feb. 16	0.10
Nabob, Ida	Jan. 17	Feb. 14	0.005
Nevada-Douglas, Nev	Feb. 10	Mar. 10	0.10
Northern Light, Ida. (post.)	.....	Jan. 27	0.004
Old Veteran, Ida	Jan. 6	Jan. 29	0.002
Ophir, Nev	Jan. 19	Feb. 10	0.05
Revenue Cons., Utah	Feb. 5	Mar. 3	0.01
Rexall, Utah	Feb. 2	Feb. 21	0.01
Rob Roy, Ida	Feb. 5	Mar. 5	0.002
Santaquin King, Utah	Feb. 8	Mar. 8	0.00125
Sierra Nevada, Nev	Jan. 19	Feb. 9	0.10
Slavonian, Ida	Feb. 1	Feb. 29	0.001
Superior & Boston, Mich	Feb. 7	.....	1.00
Tar Baby, Utah	Dec. 31	Feb. 28	0.005
Tarbox, Ida., (post.)	.....	Feb. 5	0.003
Tyler M. & M., Ida	Jan. 28	Feb. 28	0.001
Utah-Oregon, Utah	Jan. 5	Feb. 10	0.0005
Victor Cons. Utah	Jan. 19	Feb. 7	0.015
Victoria, Utah	Dec. 28	Jan. 29	0.01
Wasatch Marble, Utah	Dec. 15	Feb. 2	0.06
Western Star, Ida	Jan. 10	Jan. 31	0.001

Stock Quotations

COLO. SPRINGS	Jan. 24	SALT LAKE	Jan. 24
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05½	Beck Tunnel	.08½
Crippie Cr'k Con.	.009	Black Jack	.09
Dante	.04	Colorado Mining	.09½
Doctor Jack Pot	.11	Crown Point	.02½
Elkton Con	.32	Daly-Judge	8.00
El Paso	1.00	Emma Cop	.33
Findlay	.03½	Gold Chain	.56
Gold Dollar	.03½	Grand Central	.56
Gold Sovereign	.05	Iron Blossom	1.27½
Golden Cycle	2.02	Lower Mammoth	.06
Isabella	.20	May Day	.18½
Jack Pot	.07½	Opohongo	.02
Jerry Johnson	.05	Prince Con	.78
Lexington	‡.005	Seven Troughs	.01½
Mary McKinney	.44	Silver King Coal'n	3.40
Pharmacist	.01	Silver King Con.	2.27½
Portland	1.85	Sioux Con.	.03½
Raven B. H.	.02½	Uncle Sam	.08
Vindicator	2.45	Yankee	.26

SAN FRANCISCO	Jan. 24		
Alta	.07	Belmont	4.42½
Andes	.11	Jim Butler	.96
Best & Belcher	.04	Lone Star	.03
Caledonia	.49	MacNamara	.04
Challenge Con.	.07	Midway	.16
Chollar	.02	Mont.-Tonopah	.29
Confidence	.20	North Star	.16
Con. Virginia	.16	Rescue Eula	.07
Gould & Curry	.02	West End Con.	.82
Hale & Norcross	.04	Atlanta	.21
Jacket-Cr. Pt.	.07	Blue Bell	.02
Julia	.01	Booth	.41
Mexican	.27	C.O.D. Con	.03
Occidental	.75	Comb. Frac	.07
Ophir	.28	D'field Daisy	.04
Overman	.05	Jumbo Extension	1.32½
Savage	.04	Pitts.-Silver Peak	.06
Seg Belcher	.04	Round Mountain	.44
Sierra Nevada	.40	Sandstorm Kendall	.07½
Union Con	.63	Silver Pick	.05½
Utah Con	‡.01	Central Eureka	.08

TORONTO	Jan. 18		
Bailey	.04½	Dome Exten	.33
Chambers Ferland	.27½	Dome Lake	.26
Coniagas	4.55	Foley O'Brien	.60
La Rose	.67	Hollinger	29.00
Peterson Lake	.31½	Imperial	.04
Right of Way	‡.06	Jupiter	.20½
Seneca Superior	.73	McIntyre	.90½
T. & Hudson Bay	20.00	Porcu. Crown	.86
Temiskaming	.68	Preston E. D.	.05
Trethewey	.16	Vipond	.73
Wettlaufer-Lor.	.08	West Dome	.15½

LONDON	Jan. 7		
Alaska Tre'dwell	£7 5s 0d	Mexico Mines	£4 0s 0d
Burma Corp.	1 12 6	Nechi, pfd.	0 12 6
Cam & Motor	0 14 6	Oroville	0 12 9
Camp Bird	0 7 0	Santa Gert'dis	0 9 9
El Oro	0 9 0	Tomboy	1 3 6
Esperanza	0 10 9	Tough Oakes	0 11 10½

N. Y. EXCH.	Jan. 24	BOSTON EXCH	Jan. 24
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Gold M.	23½	Adventure	2½
Alaska Juneau	9½	Ahmeek	397
Am.Sm.&Ref.,com	103	Algomah	1½
Am. Sm. & Ref., pf.	113	Allouez	69½
Am. Sm. Sec., pf. A	93	Ariz. Com., ctfs.	8½
Am. Sm. Sec., pf. B.	87	Bonanza	.35
Am. Zinc	68½	Butte Alex. Scott	9
Anaconda	87½	Butte-Balaklava	3
Batopilas Min.	2½	Calumet & Ariz.	70½
Bethlehem Steel	475	Calumet & Hecla	560
Bethlehem Steel, pf.	130	Centennial	17½
Butte & Superior	74½	Copper Range	63½
Chile Cop.	23½	Daly West	3½
Chino	53½	East Butte	15½
Colo. Fuel & Iron	45	Franklin	9½
Crucible Steel	65½	Granby	87½
Dome Mines	27½	Hancock	17½
Federal M. & S.	27	Hedley	26½
Federal M. & S., pf.	52½	Helvetia	.50
Great Nor., ore., ctf.	46	Indiana	5½
Greene Cananea	47	Island Cr'k, com	48
Guggen. Exp.	22½	Island Cr'k, pfd.	88½
Homestake	129½	Isle Royale	28
Inspiration Con.	45½	Keweenaw	3
International Nickel	214	Lake	18½
Lackawanna Steel	79	La Salle	5
Miami Copper	37½	Mason Valley	3½
Nat'l Lead, com.	70	Mass	12½
National Lead, pf.	114½	Mayflower	3½
Nev. Consol.	15½	Michigan	1½
Ontario Min.	8½	Mohawk	91
Quicksilver	5½	New Arcadian	9½
Quicksilver, pf.	7½	New Idria	19½
Ray Con.	24½	North Butte	29
Republic I&S, com.	50½	North Lake	1½
Republic I&S, pf.	108	Ojibway	2
Sloss-Sheffield	58	Old Colony	3½
Sloss-Sheffield, pf.	97	Old Dominion	64½
Tennessee Copper	58½	Osceola	85
Utah Copper	79	Quincy	88½
U. S. Steel, com.	83½	St. Mary's M. L.	63½
U. S. Steel, pf.	118	Santa Fe	3½
Va. Iron C. & C.	56	Shannon	9½
		Shattuck-Ariz.	32½
N. Y. CURB	Jan. 24	So. Lake	7½
Alta Con	.22	Superior	25
Beaver Con	.42	Superior & Bost.	3½
Big Four	.04	Tamarack	53
Buffalo Mines	.87½	Trinity	10½
Butte & N. Y.	2½	Tuolumne	.18
Butte C. & Z.	8½	U. S. Smelting	58½
Can. Cop. Corpn.	2	U. S. Smelt'g, pf.	50
Cashboy	.04	Utah Apex	3½
Cerro de Pasco	37	Utah Con	14
Con. Ariz. Sm.	1½	Victoria	3½
Con. Coppermines	1½	Winona	4½
Con. Nev.-Utah	1/16	Wolverine	61½
Dia. Black B.	.04	Wyandot	2
Florence	.52		
Goldfield Con.	1 17/32	BOSTON CURB	Jan. 24
Goldfield Merger	.18½	Bingham Mines	7½
Hecla Min.	3½	Boston Ely	.46
Howe Sound	6½	Butte & Lon'n Dev.	.36
Kennecott Cop.	53½	Calaveras	2½
Kerr Lake	4½	Calumet-Corbin	.08
Magma	15½	Chief Con	1 3/16
Majestic	1½	Cortez	.80
McKinley-Dar-Sa.	.40	Crown Reserve	.60
Mines of Am.	3½	Davis-Daly	1½
Mother Lode	.24	Eagle & Blue Bell	1 1/32
Nevada Hills	.18	First Nat. Cop.	7½
New Utah Bingham	4	Houghton Copper	2½
Nipissing Mines	7½	Iron Cap Cop., pf.	‡7½
Oro	.05½	Mexican Metals	.65
Ray Hercules	3½	Nat. Zinc & Lead	2½
Rochester Mines	.67	Nevada-Douglas	.67
St. Joseph Lead	15½	New Baltic	4
South Utah	.30	New Cornelia	12½
Stand'd Oil of N.J.	509	Ohio Copper	.20
Standard S. L.	1 13/32	Oneco	.90
Stewart	1/32	Raven Copper	.20
Success	.72	Rex Cons.	.31
Tonopah	6½	Rilla	1 1/16
Tonopah Ex.	4½	Smokey Dev.	‡.30
Tonopah Merger	.64	United Verde Ext.	6½
Tribullion	⅛	Utah Metal	9½
White Knob, pf.	‡2		
Yukon Gold	2½	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678	47.519	27.074	25.219	22.597
August	59.293	54.344	47.163	27.335	25.979	22.780
September	60.640	53.290	48.680	27.986	24.260	23.591
October	60.793	50.654	49.385	28.083	23.199	23.925
November	58.995	49.082	51.714	27.263	22.703	25.094
December	57.760	49.375	54.971	26.720	22.900	26.373
Year	59.791	54.811	49.684	27.576	25.314	23.675

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Electrolytic	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.096	69.313	*
May	13.996	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223	18.796	60.540	76.011	64.955	91.409
August	*	16.941	‡	68.673	‡	82.333
September	*	17.502	‡	68.915	‡	85.250
October	*	17.686	‡	72.601	‡	88.000
November	11.739	18.627	53.227	77.744	○	93.273
December	12.801	20.133	56.841	80.773	*	100.43
Year	.....	17.275	.....	72.532	.....	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	*	34.389	‡	151.440
September	32.675	33.125	‡	152.625
October	30.284	33.080	‡	151.554
November	33.304	39.224	139.391	167.670
December	33.601	38.779	147.102	167.000
Av. year	34.301	38.500	.....	163.960

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	3.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891	5.659	3.738	5.531	19.051	24.611
August	3.875	4.656	3.715	4.520	‡	21.946
September	3.828	4.610	3.658	4.490	‡	23.151
October	3.528	4.600	3.384	4.499	‡	23.994
November	3.683	5.155	3.585	5.078	18.500	26.278
December	3.800	5.355	3.662	5.266	19.097	28.790
Year	3.862	4.673	3.737	4.567	.....	22.916

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.920	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	‡	67.786
September	5.380	13.440	5.230	13.270	‡	67.841
October	4.909	12.800	4.750	12.596	‡	66.536
November	5.112	15.962	4.962	15.792	25.016	88.409
December	5.592	15.391	5.430	15.221	27.369	89.400
Year	5.213	13.230	5.061	13.054	.....	67.553

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported. ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.94	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	14.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.67	13.96	13.77
July	14.90	14.94	13.90	13.91	13.90	13.68
August	14.90	16.01	13.90	15.31	14.08	14.75
September	14.90	16.86	13.90	15.95	14.03	15.70
October	14.84	16.95	13.75	15.96	13.97	15.80
November	14.59	18.26	13.43	17.30	13.83	17.20
December	14.70	19.95	13.45	18.95	13.83	18.95
Year	$14.88	$14.89	$13.78	$13.76	$14.01	$13.89